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ABSTRACT

The primary objective of this sourcebook is to help the teacher relate causes and consequences of population change to other social and environmental issues already being explored in the classroom. Sources suggested here are for use as supplementary material to be integrated into existing curricula. Divided into main sections that cover Contemporary Issues, Family Life, Health, History or Social Studies, Science, and Sociology, each chapter is also divided by concepts, and contains supportive discussion, suggested activities, references, recommended readings, and a list of relevant films. All of the chapters except two, Contemporary Issues and Sociology, are divided into Level I (most appropriate for students in grades 7-9), and Level II (geared more to the interests and abilities of high school students). (Author/OPH)

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Environment and Population

A Sourcebook for Teachers

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Note to the Teacher

In the United States, national prosperity has been based on an early abundance of natural resources and technological innovations. But growing population, industrialization, and urbanization in this country have led to a deteriorating environment, due largely to our unwillingness to recognize the necessity of regulating mechanisms.

Through the social mechanisms of technology and culture, we can alter the physical environment in unique ways to meet our own needs. In addition to our basic physiological and survival needs, such as adequate food, air, water, shelter, and clothing, we also have psychological needs, such as privacy, morality, success, contentment, and pursuit of culture—art, music, and literature.

While students are aware of something called the population "explosion," most understand little of the complex relationship between population factors and societal problems. To heighten the consciousness of interdependence, this sourcebook bases all discussions on the principle that there is a critical relationship between numbers and distribution of people and the carrying capacity of the human ecosystem. In exploring this relationship, you will need substantive information, of course, and that is provided here. But population issues also touch on such controversial areas as racism, genocide, immigration policies, and consumption patterns. The activities suggested do not retreat from these sensitive issues but often center student inquiry around them.

The primary objective of this sourcebook is to help you relate causes and consequences of population change to other social and environmental issues already being explored in your classroom. What is provided here is supplementary material to be *integrated into existing curricula.* Concepts developed in each subject area are closely related to those developed in other areas.

Each concept is followed by supportive discussion, suggested activities, references, and recommended reading matter. Each group of concepts is followed by a list of relevant films.

The Family Life, Health, History, and Science chapters are divided into Levels I and II to indicate the relative sophistication and difficulty of the concepts and activities presented. (The Contemporary Issues and Sociology chapters are entirely on Level II.) The materials labeled Level I are thought to be most appropriate for students in grades 7 through 9; those labeled Level II are geared more to the interests and abilities of high school students. You know your own students best, however. Feel free to pick and choose from any level or chapter in this sourcebook as you put together materials they will find relevant and exciting.

The National Education Association and its affiliated organizations have published a number of books, leaflets, and audiovisual materials on the environmental crisis. A free catalog may be obtained from NEA Publishing, 1201 Sixteenth St., N.W., Washington, D.C. 20036.

If you are focusing specifically on population, you might be interested in the film version of the report of the National Commission on Population Growth and the American Future (1972). The film and a teachers' guide are available on a free loan basis from Population Affairs Film Collection, National Audio-visual Center, General Services Administration, Washington, D.C. 20409.

Contemporary Issues

Introduction

A high school contemporary problems course attempts to expose students to current events. It asks that they analyze causal factors, become aware of immediate and far-reaching implications, and consider possible solutions. Subjects relevant for study in such a course fall into economic, political, environmental, and social focuses.

Rapid world population growth and the depletion and misuse of natural resources contribute to a number of current societal problems that fit easily into all four focuses. We are faced today with conditions of poverty, with nations struggling to develop their economies, with polluted air and water, with threats to certain "qualities of life," with increased restrictions on individual freedom of choice, and with political instability at home and abroad.

But to understand in what way population growth or distribution is a causal factor in these problems is extremely difficult, even for the trained demographer, ecologist, or economist. The media too often draw a simplistic picture of how population pressure affects our lives. The relationship is actually a complex and indirect one, influenced by such variables as technology, levels of consumption, degrees of industrialization and urbanization, and types of economic systems. In some areas, the pressure of numbers is a threat to people's lives; in other areas, where there is better resource distribution, the pressure of population growth threatens instead the "quality of life," subjectively defined.

To keep students from viewing population as some vague menacing evil, the contemporary issues section begins by developing concrete demographic facts and methods through discussion of the following two concepts:

Concept 1
Modern population trends are unique in human history.

Concept 2
For the first time in human history, fertility is becoming the problem causer in world population change.

Having gained an understanding of just what factors cause a high population growth rate, how doubling time varies, etc., students should then be able to examine the complex way in which demographic factors affect the social and physical environment. Through discussion of the following concepts, they should come to recognize that population is a causal factor in all the problems mentioned, but not a direct one.

Concept 3
The struggle of many nations to develop their economies is prolonged and made more difficult by their rapid population growth.

Concept 4
Because of growing concentrations of both people and industry, the carrying capacities of urban areas are being altered through limitation and misuse of land, air, and water.

Concept 5
A certain "quality of life," as defined by individuals, is threatened in densely populated areas because of resource limitation and misuse.

Concept 6
With more people making use of a limited supply of resources, greater regimentation of use becomes necessary to ensure equitable distribution. Such regimentation for the benefit of the society may limit the freedoms of the individual.

Concept 7
Political instability is foreseeable as long as a few nations continue to consume a disproportionate quantity of the earth's finite supply of resources.

Level II

Concept 1

Modern population trends are unique in human history.

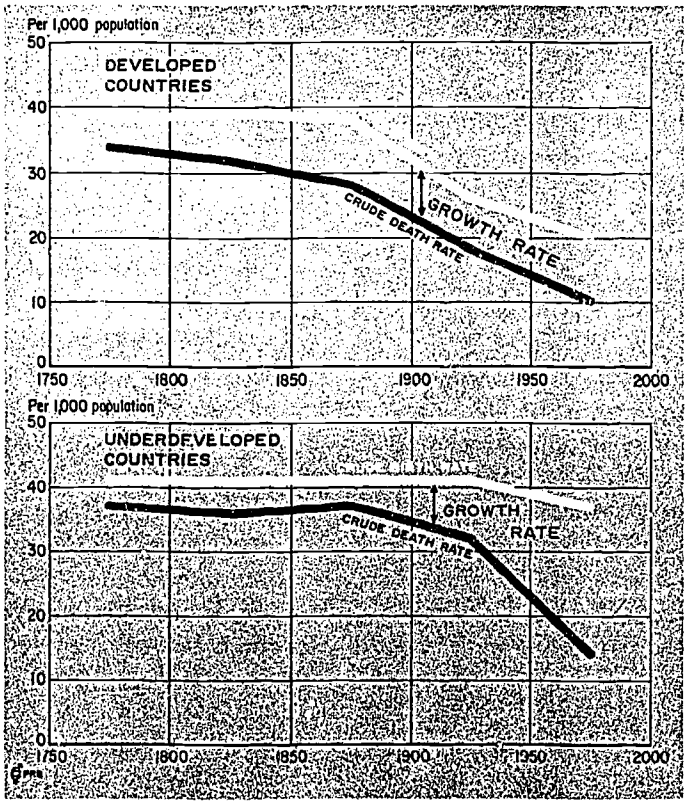
Discussion

All nations that have moved from a traditional agricultural economy have also shifted from a pattern of *high* death rates and birth rates to one of *low* death rates and birth rates. In spite of these shifts, great increases in population have occurred, because death rates have either declined first or declined more rapidly than birth rates. This gap between birth and death rates has narrowed in modern Western nations, which have completed the demographic transition, but these nations have only a minority of the world's population. Most Asian, African, and Latin American nations now have low death rates but still very high birth rates. (See figures 1-3.)

The demographic transition in the Western nations was both preceded and followed by

FIGURE 1

Estimated Birth and Death Rates, 1770-1970

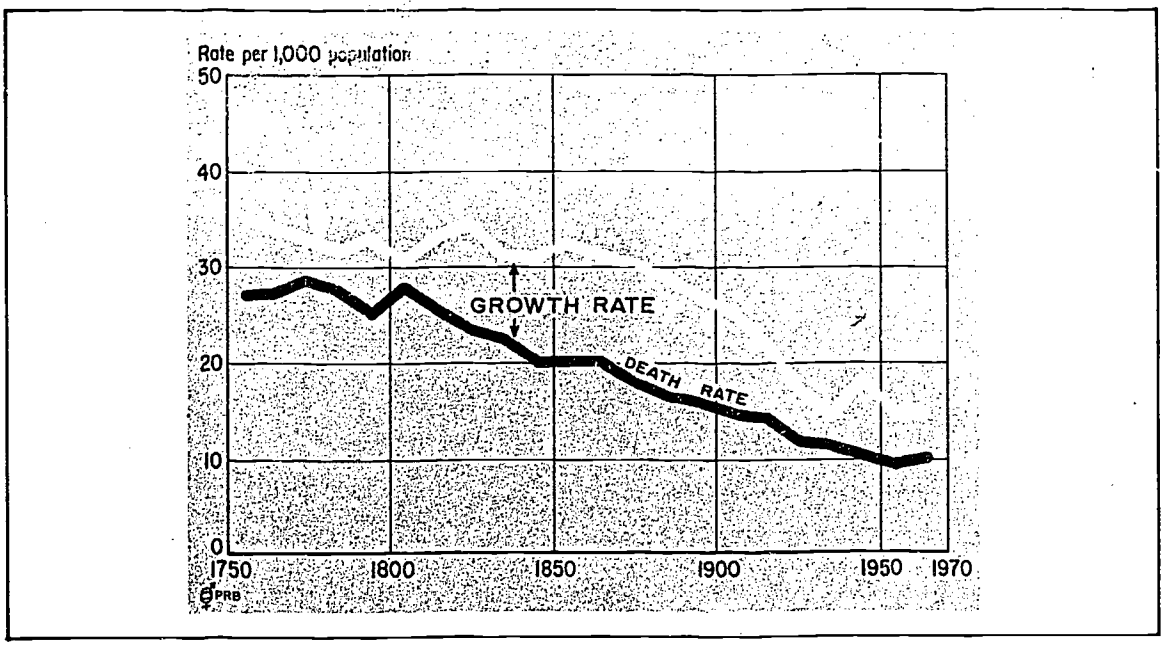


Source:

Developed by the Population Reference Bureau, Inc., from data in United Nations. *A Concise Summary of the World Population Situation In 1970.* New York: United Nations, 1971. Graphs reproduced with permission from *Population Bulletin.* April 1971. p. 14.

FIGURE 2

A Demographic Transition: Sweden, 1750-1968

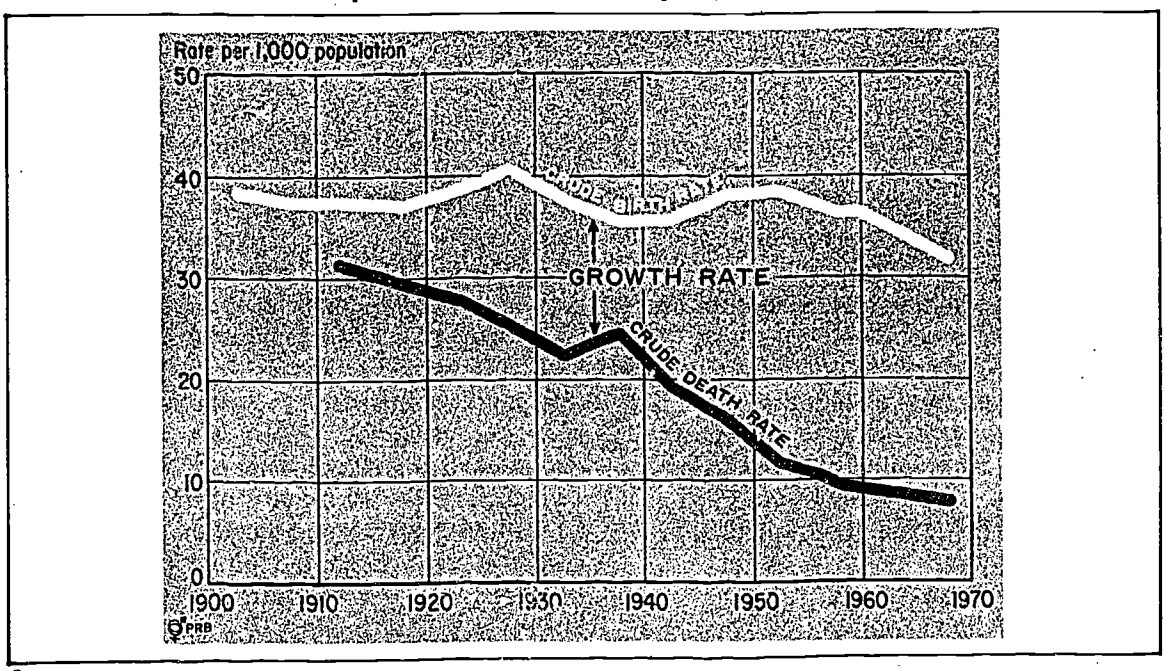


Source:

Developed by the Population Reference Bureau, Inc., from data in National Central Bureau of Statistics. *Historical Statistics of Sweden. Part 1, Population.* Second edition, 1720-1967. Stockholm: K. L. Beckmans Tryckerier AB, 1969. Graph reproduced with permission from *Population Bulletin,* April 1971, p. 17.

FIGURE 3

Explosive Growth Rate: Ceylon, 20th Century

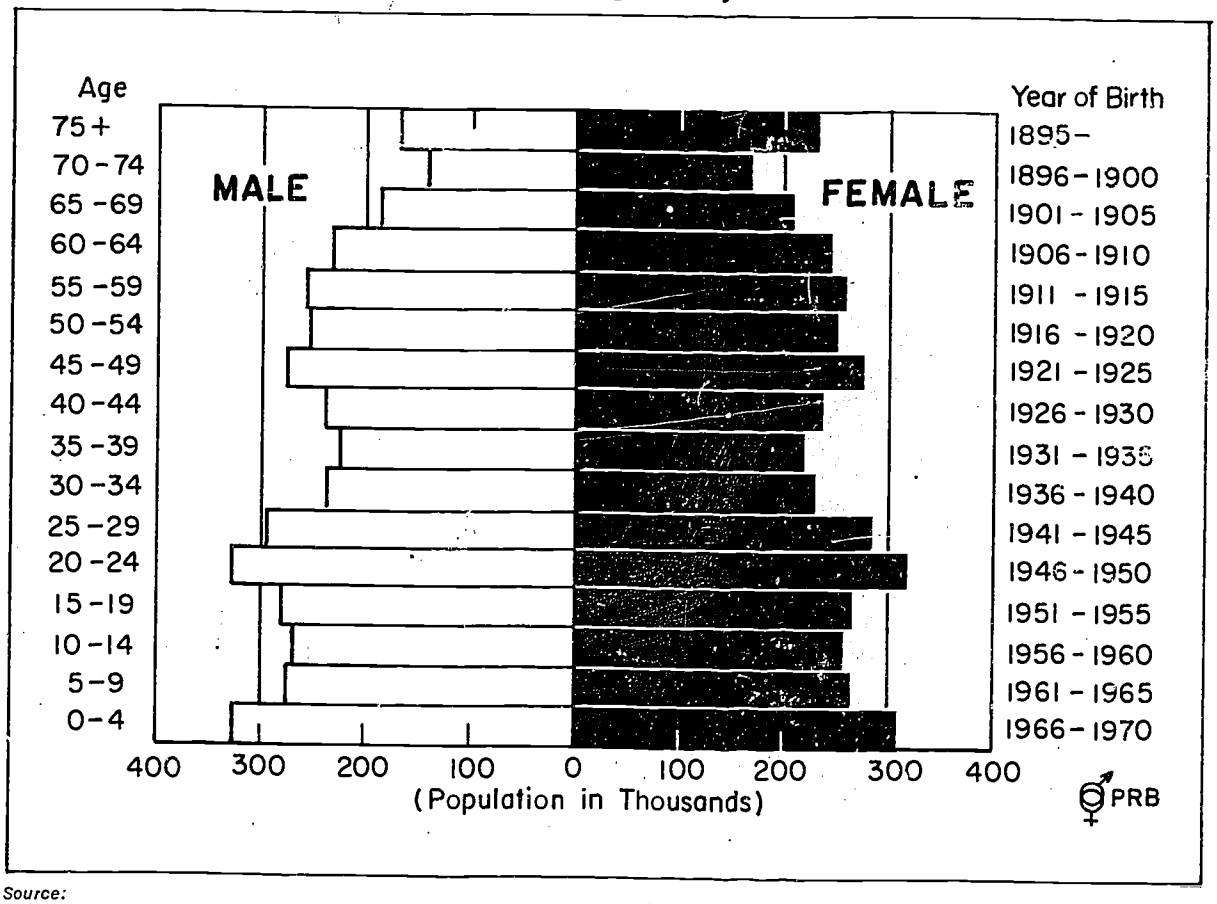


Source:

Developed by the Population Reference Bureau, Inc., from data in United Nations. *Population Bulletin of the United Nations, No. 6* (ST/SOA Series N/6) and *No. 7* (ST/SOA Series N/7). New York: United Nations, 1972. Graph reproduced with permission from *Population Bulletin,* April 1971, p. 18.

FIGURE 4

Sweden: 1970 Age-Sex Pyramid



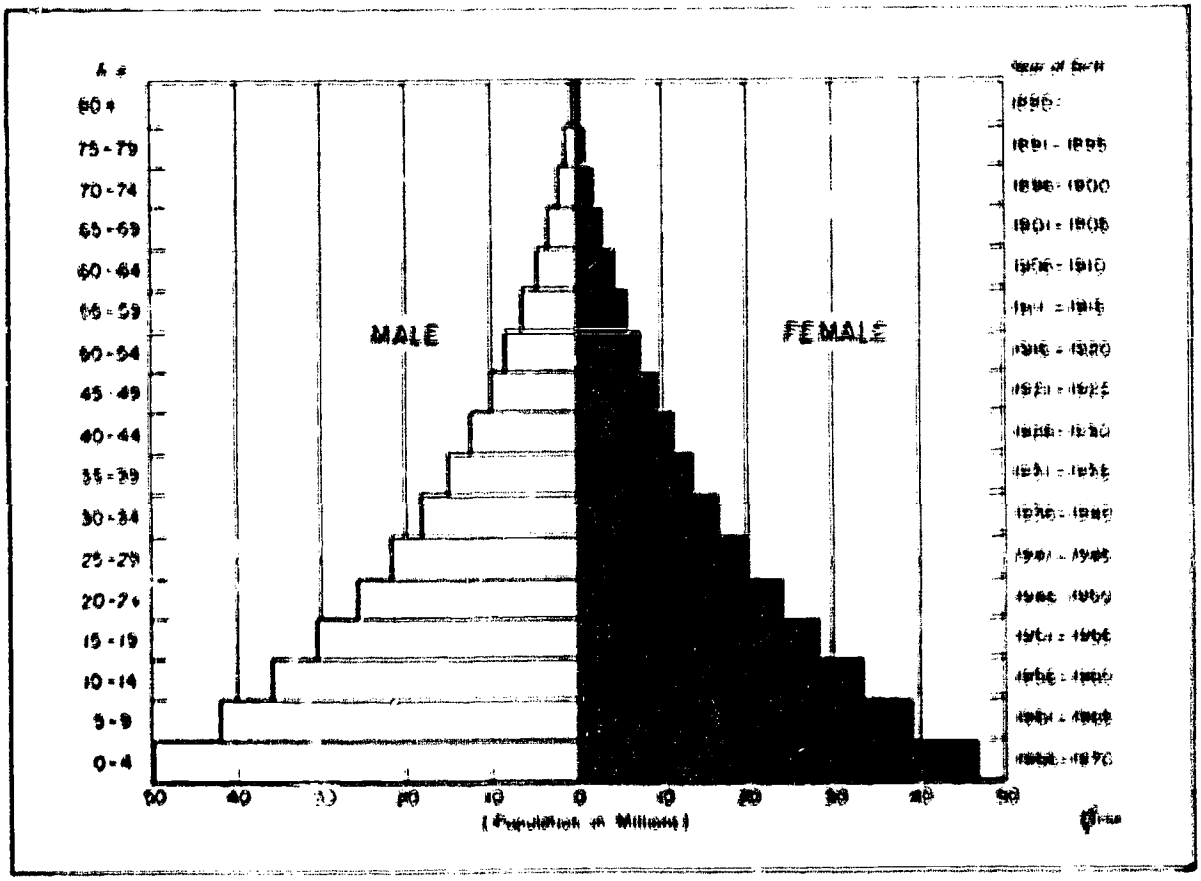
Source:
Developed by the Population Reference Bureau, Inc., from data in UN Population Division Working Paper No. 11. Graph reproduced with permission from *Population Bulletin*, November 1970. p. 3.

other related changes. One was a shift in the ratio of consumers to producers, resulting from a change in age distributions. The age structure of a population depends primarily on the birth rate, not the death rate. In most Western countries, because the birth rate has declined, children (consumers) constitute a decreasing proportion of the population, and older people (producers) an increasing proportion. (Elsewhere, because only death rates have fallen, the number of children is high and the child dependency burden remains heavy. The falling death rates have been due chiefly to the decline in infant mortality. Even though people are also living longer, the population in non-Western nations is becoming younger, not older, because of the increasing number of babies who are surviving. See figures 4 and 5.)

Another significant change in the developed nations has been the massive movement from rural to urban areas. The U.S. population, for example, is now over 70 percent urban. We often hear that our population problems are due more to the heavy migration of people into urban areas than to the size and growth of the total population, and that a redistribution would solve our problems. The issue is not that simple. We are already a metropolitan nation. Two out of three Americans now live in metropolitan areas, and this trend will continue. Metropolitan population growth will increasingly reflect changes in national birth rates. Over the last 10 years, 70 percent of metropolitan population growth resulted from natural increase, according to the Commission on Population Growth and the

FIGURE 2

India: 1970 Age-Sex Pyramid



Source

Developed by the Population Reference Bureau, Inc., from data supplied by International Demographic Statistics Center, U.S. Bureau of the Census. Graph reproduced with permission from *Population Bulletin*, November 1970, p. 9.

American Future. In other words, if there had been no net immigration at all into the metropolitan areas, these areas would have experienced most of their growth anyway.

The world urbanization process, as human ecologist Amos Hawley has pointed out, means that larger populations and areas are being included in one system of exchange, influence, and division of labor. Units of political, social, and economic interaction are becoming larger and larger, often crossing political boundaries.

The present rate of world population growth—2 percent per year—cannot continue far into the future. Because of the finite carrying capacity of the globe, any growth rate will eventually result in exhaustion of space itself as well as of the supply of natural resources.

The curve of human population must follow one of three possible courses:

(1) It could continue to rise for a brief period and then gradually level off to some stable magnitude capable of being sustained by the world's energy and material resources for a long period of time.

(2) It could overshoot any possible stable level and then drop back and eventually stabilize at some level compatible with the world's resources.

(3) Finally, as a result of resource exhaustion and a general cultural decline, the curve could be forced back to a population corresponding to the lowest energy-consumption level of a primitive existence.

For one type of behavior for this curve that is not possible is that of continued and unlimited growth. To see that limits do exist, one need only consider that if the present world population were to be doubled but 15 more times, there would be one man for each square meter on all of the land areas of the earth, including Antarctica, Greenland, and the Sahara Desert. And at the present rate of growth, this would require but 525 more years (Hubbert 1969, p. 238).

Activities

1. Have students gather statistics on several nations' birth rates and death rates, and then determine where in the demographic transition each nation fits. The latest "World Population Data Sheet" is a good source of statistics (see References).

2. Have students (a) get early world population figures from *Population*, by William Peterson, and (b) make display charts of the growth curve along the time scale, showing the addition of each billion people to the earth's population. Arrange the display for the benefit of the entire school.

3. Present the class with charts of four or five different age structure distributions. Help them determine, through discussion, the approximate birth and death patterns of each. If necessary, refer to *Population Problems*, by Thompson and Lewis.

4. Have students pick one underdeveloped country that has yet to lower its birth rate and that has a high child dependency burden (El Salvador, for example), and discuss the implications of these conditions for its future economic development.

5. Ask students to read Ch. "Immigration," in *Population: An American Future* (see Refe- informing them that approx. [illegible] of the annual U.S. growth rate is due to immigration, ask them to debate the question, "Should the U.S. change its immigration policy to help slow its population growth?"

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Concept 2

For the first time in human history, fertility is becoming the problem cause[r] in world popul[ation] change.

Discussion

The factors influencing the size and characteristics of human populations are—

- The number of births (fertility).
- The number of deaths (mortality).
- The number of people coming into or leaving an area (immigration or emigration).

The crude birth and death rates are figured from the following equations:

$$BR = \frac{\text{number of births in a year}}{\text{population}} \times 1000$$

$$DR = \frac{\text{number of deaths in a year}}{\text{population}} \times 1000$$

The difference between the birth and death rates is called the *rate of natural increase*. When changes due to immigration or emigration are figured in, this rate becomes the *population growth rate*. Although birth and death rates are expressed as parts per 1,000, population growth rates are usually expressed in percentages—parts per 100. For example, Cambodia's 1972 growth rate of 30 per thousand is 3.0 per 100 or 3 percent.

A country with a growth rate of 1 percent (e.g., the United States) will double its population in 70 years. The world, with an overall growth rate of 2 percent, will double its population in half that time (35 years). The formula for figuring "doubling time" is as follows:

$$\text{Doubling time (in years)} = \frac{70}{\text{growth rate}}$$

For example, $\frac{70}{2.0 \text{ percent}} = 35$ years.

Table 1 (page 16) shows how doubling times have been reduced since the year 1 A.D.

A more detailed discussion of population indicators will be found in Appendix A.

Activities

1. Have students consult state census or health department data to learn the birth rate, death rate, growth rate, and doubling time of their county, state, and country. Have available similar data for other nations to encourage comparison and discussion. Use the latest "World Population Data Sheet."

2. Ask interested students to read *The Year 2000*, by Kahn and Wiener (see References), and then to take roles as "futurists," discussing their own lives as they see them in 30 to 50 years.

3. Encourage students to do research in order to answer the questions that follow. If possible, have a college student or professor of demography available for one work session to help with demographic research techniques.

- How old will you be when the U.S. population is half again as large as it is now? When the *world* population is half again as large?
- How old will you be when the U.S. population is twice as large as it is now? When the *world* population is twice as large?
- How many children would American women, on the average, have to bear in order to exactly replace the U.S. population?
- How many years would it take to increase the U.S. population by one-half if American women on the average had exactly three children? Exactly two children?

4. Have students (a) do a comparative study of the fertility and population doubling time

TABLE 1

World Population Doubling Times

Year	*Population*	*Doubling Time*
1 A.D.	250,000,000	
1700 A.D.	500,000,000	1,700 years
1850 A.D.	1,000,000,000	150 years
1930 A.D.	2,000,000,000	80 years
1970 A.D.	3,500,000,000	
2005 A.D. (projected)	7,000,000,000	35 years

of several different nations, and (b) arrange a bulletin board or hall display showing their findings. For information on specific countries write to the Population Reference Bureau, Inc., 1755 Massachusetts Ave., N.W., Washington, D.C. 20036, or to The Population Council, 245 Park Ave., New York, N.Y. 10017.

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For Further Classroom Use

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Concept 3

The struggle of many nations to develop their economies is prolonged and made more difficult by their rapid population growth.

Discussion

The "have-not" nations are striving to achieve higher living standards by making economic development their number one national priority. To speed up the modernization process, an economy must increase its level of net investments: it must make additions to its factories, roads, irrigation networks, and other production facilities and must make the most effective combined use of labor, capital, and natural resources. But this process is hindered by certain effects of high fertility levels. The explanation that follows is based on the research of Ansley Coale.

A population with a high fertility level must use nearly all of its total national income for consumption, because of the heavy burden of dependency upon its people of working age. (See the analysis of age distributions in Concept 1.) After 25 years in a high fertility country, hypothetically, there would be 96 dependent persons (mainly those aged 0 to 15) for every 100 persons in the productive ages (15-64). After 25 years in a low fertility country there would be only 65 persons in the dependent ages for every 100 persons in the productive years. Thus fertility levels affect the age distribution of a population, which in turn affects economic status.

In a capitalist economy, families that have many children and more difficulty in saving reduce the national volume of savings and, hence, the level of investment. In other types of economies, where low-income families are not an important source of savings, higher fertility creates social pressure to increase the share of national income received by the poorer people so that they can meet minimum levels of consumption. Even where the government, rather than the individual investor, provides most of the national investment, the fertility level still affects the level of investment through its effect on tax revenues.

> For any given level of deprivation that [a government] is prepared to impose, it can raise more taxes from a low fertility population than from a high fertility population with the same national income and the same number of adults. . . . (Coale 1969, p. 69)

So a nation that has reduced its fertility level reaps the double benefit of dividing its national product among a smaller number of consumers and of having a larger national product to divide.

The growth of the labor force is another crucial factor in economic development. A larger labor force requires a larger stock of resources in order to have the same productivity per head. The percentage of national income required for investment is three times the annual rate of labor force increase.

> In other words, if the labor force were growing by 3 percent a year, a level of net investment of 9 percent of national income would be required to prevent declining productivity, while if the rate of growth of the labor force were 1 percent a year, the needed level of investment for this purpose would be only 3 percent of national income. (Coale 1969, p. 70)

The Princeton Office of Population Research has estimated that a 50 percent fertility rate reduction, through its effect on population numbers, age distribution, and capital formation, could more than double the growth rate of India's per capita output in two generations. The rise in output results from having the same number of producers and a decreasing number of consumers, which decreases the proportion of national output that need be used for current consumption and thus promotes the mobilization of resources for economic growth.

Activities

1. Have students make a world display chart showing each country's per capita income and percentage of the population working in agriculture, as well as its literacy, fertility, and population growth rates. Rely in part on the current "World Population Data Sheet."

2. At the beginning of the course let each student choose one underdeveloped country on which to collect current national development plans and reports. These can be found in periodicals, newspapers, and the international economics section of a large library. Encourage students to study the population policies, if any, of their chosen countries, to determine what part they play in economic development plans. Have the class make a large chart showing which countries have official population policies.

3. Have each student find out whether his or her chosen country offers family planning services to its population, what goals the family planning program has set, and what progress has been made to date. Again have the class design a chart on which to display this information.

4. Organize a class debate on the following topic: "The United States should give economic aid only to countries committed to reducing their fertility rates." Encourage students to face the moral and political dilemmas this issue poses. Discuss the accusation of black and third world genocide. Can the United States legitimize such an aid policy when it has no official population policy of its own? Do we in the United States have a special responsibility to reduce our population growth, because of our disproportionate consumption patterns?

5. Have students read and prepare to discuss President Nixon's "Message on Population" of July 18, 1969 (see References). Focus on the section pertaining to family and population planning problems and progress in both "developed" and "developing" nations.

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Concept 4

Because of growing concentrations of both people and industry, the carrying capacities of urban areas are being altered through limitation and misuse of land, air, and water.

Discussion

Urbanization has been a striking feature of economic growth in the United States and other countries, including those just beginning the industrialization process. The modern natural resource problem is not scarcity, but rather social adjustment to the ill effects of technological change and economic growth. Scientific progress, in the process of serving an expanding population, is rendering plentiful resources unusable. Our water supply, for instance, contains an ever increasing amount of detergents, insecticides, dyes, petroleum wastes, herbicides, radioactive wastes, and human wastes. The rate at which we pollute our water goes up with increases in our population and in our material standard of living. We find ourselves in a paradoxical situation: while water needs increase with a growing population, the same growing population renders the potentially renewable resource unusable.

Air pollution is caused by the same three factors that cause water pollution: greater concentrations of people and industry, higher levels of consumption, and population growth. The atmosphere has increasingly become a waste trap.

> Multiple deaths have been caused (as at Donora, Pennsylvania) and whole communities have been subjected to distress and possibly damage to health (as in Los Angeles), or seriously inconvenienced (as in Pittsburgh and London). Four of the world's leading nations have found it necessary, each according to its own calculations of benefits and costs, to increase worldwide radioactive fallout. (Barnett and Morse 1963, p. 255)

Yet a third resource—land—is being consumed by population expansion and despoiled by waste and debris. Some areas are stripped of plant and animal life by noxious gases; others are spoiled by urban dumps, automobile scrap piles, and vacant lots strewn with bottles, cans, and other trash.

Most of the U.S. population increase in the next few years will not be spread evenly over the nation but will be concentrated instead in already crowded cities. By the year 2000, this could mean that approximately 80 percent of us will live on 8.7 percent of the land. The decisions about the use of natural resources are of crucial importance and can hardly be left to scientific and economic interests alone. We must be *socially* innovative if our scientific innovations are to bring anything but a decreased quality of life.

Activities

1. Have students (individually or in groups) visit an industrial plant to determine methods of waste disposal. Encourage them to speak with an official to get the company's stated policy on pollution controls. As a follow-up, have them check with the local environmental health officer to verify whether the policy is actually put into action. Have the students report their findings to the class.

2. Ask the class to make a list of the types of pollution they themselves have experienced, and then to add types they have heard or read about. Encourage them to document each type of pollution with a clipping or photograph.

3. Lead the students into a discussion of which types of pollution are partly caused by population growth. Consider direct and indirect relationships.

4. Have students investigate (by examining census material or doing other reading) in what way U.S. cities are growing as compared to the cities of developing countries—primarily through migration or simply through natural population growth? What are the future trends?

5. Invite a city planner to speak to the class on how he and his colleagues plan for growing cities over a 10-year period and over a 25-year period.

6. Have the class send for the *Congressional Record* at the beginning of the school year so as to follow the progress of all bills having anything to do with environmental and pollution problems, population policy, or family planning programs. Encourage students to write to their Congressmen to express positive or negative views on proposed legislation.

7. Suggest that class members take a "car census" of the school, collecting figures on number of cars per family, average time of use per car per family, how many students own cars, how many younger brothers or sisters will own cars when in high school. Interested students will want to trace nationwide car sales and the increase in cars per capita over the last 30 years. Hold a class discussion of future implications of car consumption and population growth.

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For Further Classroom Use

See resources listed on page 22.

Concept 5

A certain "quality of life," as defined by individuals, is threatened in densely populated areas because of resource limitation and misuse.

Discussion

In the poorer countries population growth can so impoverish people that life itself is threatened. But in the industrial countries the most noticeable consequence of population growth is a threat to the *quality* of life enjoyed by most citizens. Of course, urbanization, industrialization, and rising levels of consumption can have destructive effects on the quality of life even in a small, stable population. But when the population size increases at the same time as a society's material expectations rise, the difficulties are compounded. The growing traffic congestion in Europe and America is a result of the rise in affluence coupled with population expansion.

> The worst effects of environmental pollution are probably yet to come, since it is only during recent decades that certain chemical pollutants have reached high levels almost everywhere and that children have been exposed to these pollutants almost contantly from the time of birth. (Dubos 1970, p. 2)

Is the present system producing the kind of physical environment we want for ourselves and our children? If it is not, are we willing to pay the price—in dollars and in restrictions—for a better environment? If we are not, we can still be fairly sure that the human race will at least survive, because human beings can adapt to almost anything.

> But that is the real tragedy—we can adapt to it. It is not man the ecological crisis threatens to destroy but the quality of human life, the attributes that make human life different from animal life. (Dubos 1970, p. 2)

Louis Pasteur was among the first to study the dangers inherent in adaptability.

> Pasteur pointed out that most human beings crowded in a poorly ventilated room usually fail to notice that the quality of the air they breathe deteriorates progressively . . . because the change takes place by imperceptible steps.
>
> Then, to illustrate the danger of such adaptation to an objectionable environment, Pasteur placed a bird in a closed container . . . for several hours. The bird became rather inactive but survived. In contrast, when a new bird of the same species was introduced into the same cage . . . , it immediately died. (Dubos 1970, p. 2)

Further elaboration on the concept of human adaptability can be found in the Health chapter of this book, pages 44-58.

Activities

1. Have students define what makes up the quality of their own and their families' lives. Have the class then list and discuss the natural resources necessary to maintain that quality of life. Which of the resources are limited? Which are currently being misused?

2. Encourage students to write letters to their school and community newspapers pointing out how a growing population contributes to the depletion and misuse of the resources necessary for certain activities almost everyone enjoys.

3. Ask the class to read the Calhoun, Schmitt, and Rosenberg articles listed in the References and then to prepare a discussion, debate, or other project on the effects of population density to present to the high school sociology or psychology class.

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Concept 6

With more people making use of a limited supply of resources, greater regimentation of use becomes necessary to ensure equitable distribution. Such regimentation for the benefit of the society may limit the freedoms of the individual.

Discussion

The average American is both more free and less free today than he has ever been before. Certainly his freedom has been increased by the vast improvement in his economic condition, but at the same time it has been decreased as a result of the side effects of scientific technology and the increasing size and concentration of the population.

As an illustration of how restrictions become necessary, consider the growth of the waste disposal problem in urban centers. Originally, families in sparsely settled areas were free to dispose of their wastes on a self-interest basis; in so doing they did not adversely affect the environment of others. This habit carried over when cities began to develop. As an alternative to using the streets as sewers, the more progressive cities established direct discharge into rivers, lakes, and oceans. This method is logical if only local interests are considered, but extremely disfunctional when several large communities use it independently.

Currently, the problem is intensified by the huge volumes of wastes created by modern industry. In terms of individual interests, industries find it economical to let their wastes flow downstream, but such disposal methods inevitably reduce and often destroy the water's value for recreational and other uses by the general public and specifically by the downstream communities. So waste disposal, like many other problems, once a matter solely for individual decisions, has become a problem requiring social decision processes. In our urbanized society, with its increasing economic and social interdependence, the number of individuals affected by any one decision is getting bigger and bigger.

Water, of course, is a resource for which we have no substitute, yet at the same time it has been a relatively free good. Modern societies have used it lavishly. Now, however, rapid population growth and expanding industrial needs have begun to strain the available water supply in many areas, including the American Southwest. It is likely that the institutional arrangement, and perhaps even the values, concerning water use and distribution will be forced to change.

> One possibility is adoption of the price system as a device for rationing the use of water whenever its increased availability is subject to increasing cost. Another possibility is to change value standards concerning the use of water—to foster and develop a resource-saving ethic so far as water is concerned. (Barnett and Morse 1963, p. 256)

When the U.S. population doubles, as it will in about 70 years at our present rate of growth, imagine the necessary additions to the already existing controls—pollution ordinances, building codes, zoning restrictions. We should realistically expect that soon even the rural areas—the family farm and that "place in the country"—will be tightly controlled for the most profitable use.

Activities

1. Let students figure out the number of people a Congressman in the year 1900 might have represented if Congressional districts had been determined by an equal division of total U.S. population. (There were 391 districts in 1900; U.S. population was 76,212,168.) How many people would today's Congressman represent if Congressional districts were determined by an equal division of the U.S. population? (There are 435 districts today; U.S. population in 1970 was 203,184,772.) Discuss the difference between 1900 and 1970 and its implications for the individual's voice in a democracy.

2. Ask students to read "Will Success Spoil the National Parks?" by Robert Cahn (see References). Invite an official from the National Park Service or your state's

park service to trace the use of state and national recreation areas over the past 25 years. How do the parks plan for the growing numbers of visitors? Ask the official to discuss such problems as close-together campsites, the need to reserve sites far in advance, and traffic congestion in the parks.

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Concept 7

Political instability is foreseeable as long as a few nations continue to consume a disproportionate quantity of the earth's finite supply of resources.

Discussion

Rising expectations for the poor is a cruel joke foisted upon them by the Establishment. As our new economy of use-it-once-and-throw-it-away produces more and more products for the affluent, the share of our resources available for the poor declines. (Davis 1970, p. 15)

The statement above is applicable on a worldwide basis as well as within our own economy. Since no individual, group, or nation can possibly have control over all life conditions, the consequences of actions must be weighed in light of their value for other individuals, groups, or nations. The United States, comprising only 6 percent of the world's population, consumes between 30 and 50 percent of the nonrenewable resources used each year. Yet because our culture is so tightly woven around the view of land and minerals as property to be exploited in any economically feasible way for individual financial gain, the only solution many Americans can suggest to this consumption imbalance is to reduce the birth rates in those "other" societies.

At the same time that foreign assistance budgets are shrinking overall, Congress has been earmarking increasing amounts for international population program assistance. . . .

. . . encouraging fertility reduction among foreign peoples, important as such a goal might be, almost inevitably will evoke nationalistic resistance, as programs challenge beliefs ranging from national virility to tenets of international power politics. Making population the cornerstone of development assistance could raise enough opposition in recipient countries to render both programs ineffective. (Population Reference Bureau 1972, pp. 19, 20)

Even within the United States, sectors of the black population accuse governmental family planning programs of "racial genocide" because of a heavy focus of birth control efforts in ghetto communities. In a position paper presented to the President's Commission on Population Growth and the American Future, Dr. Charles V. Willie summarized the reasons why many blacks cannot easily dismiss the genocide charge:

Let me explain why blacks believe any national program for family stability which focuses upon family planning is a desperation move on the part of whites to remain in control. Whites were not concerned about the family structure of blacks a century and a half ago. Then, blacks were nearly one-fifth (18.4 percent) of the total population. This, of course, was during the age of slavery, during the 1820s. Then, blacks were not free. They were no challenge to whites. Although they represented one out of every five persons in the United States, and although the family assumed even more functions for the growth, development and well-being of individuals then than it probably does today, American whites were not concerned about the fertility or stability of the black family. . . . Neither the size of the black population nor their circumstances of family life worried white Americans before black people were free.

But come the mid-1960s, when the throttle to the Freedom Movement was open and demonstrations for self-determination were going full blast, white Americans became concerned about the size and the stability of the black family. Daniel Patrick Moynihan tipped off blacks about what was in the minds of whites when he described the situation as "acute" because of the "*extraordinary* rise in Negro population." The size and stability of the black family . . . is a cause for alarm among white Americans, requiring a national program of family control, now that black people are beginning to achieve freedom and equality.

Blacks, of course, would not claim that there has been an extraordinary rise in the Negro population. The black population in America has increased from 9.9 percent in 1920 to approximately 11.1 percent today—no cause for alarm. But then, maybe an increase of between one and two percentage points of the total population is an extraordinary rise if one believes it is.

Activities

1. Have students write to the Agency for International Development, Information Office, Washington, D.C. 20523, for the history and present status of U.S. aid to foreign countries. Encourage them to ask for instances or proposals of aid being made contingent upon the receiver nation's establishing family planning programs to reduce its birth rate.

Discuss the issues in class. Has the United States a right to withhold surpluses and economic aid from any country? Would such a policy be more justified if our own population policy were stronger?

2. Duplicate and distribute to the class the presidential statements on population in Appendix B. How has presidential policy changed? Do presidential statements have any influence on couples planning the size of their families?

3. Encourage students to read "Whose Baby Is the Population Problem?" (see References). Have each student survey his or her parents' attitudes on U.S. population policy. Questions might include, What countries are contributing to present pressures? Why? Which groups in the United States have the highest fertility? Which groups consume the most?

Hold a class discussion of the survey findings, and clarify the issues. Do the majority of the students agree with parental attitudes? Are parents misinformed?

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Films

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People by the Billions. 28 min., 16mm, b & w. Contemporary Films/McGraw-Hill, 330 W. 42nd St., New York, N.Y. 10036. 1961. *Gives historical view of the death rate decline, then focuses on present-day growth and crowding on all continents.*

Population Ecology. 19 min., 16mm, color. Encyclopaedia Britannica Educational Corporation, Rental Library, 1822 Pickwick Ave., Glenview, Ill. 60025. 1964. *Gives facts of population growth in a variety of organisms. Includes lab demonstrations of different animal responses to the same environmental limits. Portrays fluctuation and limitation of population sizes as the environment changes, and explains population growth curve through the history of mankind. Concludes that we too must be governed by natural laws and indicates alternative ways of limiting population: starvation, disease, war, birth control planning.*

Mauritius. 30 min., 16mm, b & w. Planned Parenthood/World Population, Audio-Visual Service, 810 Seventh Ave., New York, N.Y. 10019. Mid-1960's. *Entire film devoted to the population "explosion" on the island of Mauritius, representative of the earth in microcosm. Most social problems—unemployment, political instability, sluggish economy, etc.—are seen as direct consequences of rapid population growth.*

The Population Problem: Japan, Answer in the Orient. 60 min., 16mm, color. Indiana University, Audio-Visual Center, Bloomington, Ind. 47401. 1966. *Historical and sociological view of Japan, focusing on population change. Describes relationship of population growth to Japan's military conquests and expansion in the past 100 years.*

The Population Problem: India, Writings in the Sand. 60 min., 16mm, color. Indiana University, Audio-Visual Center, Bloomington, Ind. 47401. 1964. *Details the effects of India's uncontrolled population growth on her economy, focusing on cultural and religious resistance to change. Interviews show upper and middle classes and governmental officials very concerned over too rapid growth. Gives basic understanding of causes and consequences of population growth in Indian society.*

The Population Problem: The USA, Seeds of Change. 30 min., 16mm, b & w. Indiana University, Audio-Visual Center, Bloomington, Ind. 47401. 1966. *Focuses on societal problems of congestion, commuting, inner-city life, migration to the suburbs, loss of fertile land, poverty, inadequate recreation and education facilities, as they are affected by population growth. Points directly to the need for the U.S. to respond to its own population pressure.*

Boomsville. 11 min., 16mm, color. Learning Corporation of America, 711 Fifth Ave., New York, N.Y. 10022. 1969. *Short animated film produced by the National Film Board of Canada, depicting the historical sequences of modern civilization, particularly migration to North America. Little emphasis on population growth, but accurate portrayal of urban growth and related problems. No narration.*

The Changing City. 16 min., 16mm, b & w. Churchill Films, 662 N. Robertson Blvd., Los Angeles, Calif. 90069. 1963. *Presents the social, economic, and cultural opportunities of the city and traces urban growth through history to the present urban explosion. Urban problems—land use conflicts, blighted areas, population density, displacement and urban renewal—are presented as cases in need of sophisticated planning. Special emphasis on transportation.*

House of Man: Our Changing Environment. 17min., 16mm, color. Encyclopaedia Britannica Educational Corporation, Rental Library, 1822 Pickwick Ave., Glenview, Ill. 60025. 1965. *Contrasts the natural ecosystem of a pond with man's environment, the city. Questions whether the problems of urban sprawl, pollution, and slums must be the perpetual legacy of the Industrial Age. Shows planning as the key to breaking this legacy. The film's strong points are its tracing of the history of world population growth and resource use and its presentation of a value orientation other than the economic one.*

Multiply and Subdue the Earth. 60 min., 16mm, color. Indiana University, Audio-Visual Center, Bloomington, Ind. 47401. 1967. *Emphasizes land as a precious resource and dictates ecologically sound land use. Economic gain as the basis for land-use planning is severely criticized. Case studies of New Jersey, Minnesota, Tahoe, Baltimore, and Hawaii convey the need for reform in taxing and zoning.*

Tragedy of the Commons. 23 min., 16mm, color. King Screen Productions, 320 Aurora Ave., N., Seattle, Wash. 98109. 1971. *Shows population growth first through analogy with the overgrazed common pastureland, then through examination of the degradation of urban life. Brings attention to black people's mistrust of the entire ecology/population movement. Makes clear statement that population must be controlled.*

Urban Sprawl vs. Planned Growth. 22 min., 16mm, color. Stuart Finley, Inc., 3428 Mansfield Rd., Falls Church, Va. 22041. 1968. *Shows haphazard patterns of urban growth and cites planning done in Brandywine Creek, Pa. Major theme is need to understand the environment before changing it in any way.*

Beyond Conception. 35 min., 16mm, color. Population Dynamics, 3829 Aurora Ave., N., Seattle, Wash. 98103. 1968. *Emphasizes the causes and consequences of the population explosion. Shows environmental deterioration, food production, and social pressures as problems impossible to solve without curbing population growth. Discusses birth control methods and the responsibility of each individual for avoiding unwanted pregnancies.*

To Each a Rightful Share. 30 min., 16mm, b & w. McGraw-Hill, Film Preview Library, Princeton Rd., Highstown, N.J. 08520. 1961. *Contrasts the "have" and "have-not" nations in the battle for strategic resources. Shows Western man's wasteful use of these resources.*

Tomorrow's Children. 17 min., 16mm, color. Perennial Education, 1825 Willow Rd., Northfield, Ill. 60093. 1971. *A strong indictment of man's refusal to follow nature's laws of balance. Shows our potential to respond to the physical and psychological needs of our future children through control of our consumption and reproduction patterns.*

Family Life

Introduction

The very traditional home economics or family life course is designed to help students secure abilities, information, and understandings useful as they prepare for the establishment of their homes. In contrast, the objective of the concepts developed here for use in a not-so-traditional course is to help students secure abilities, information, and understandings useful as they prepare for fulfilling life activity, whether it be in the home or outside.

Women's roles and opportunities have particular bearing on demographic patterns. Every society has its ways of channeling reproductive behavior, both formally and informally, through social institutions and cultural norms. In American society we find specific, institutionalized pronatalist (probirth) pressures:

(1) the socialization of the young into sex-typed roles, with the boys pointed toward jobs and the girls toward home and motherhood,

(2) discrimination against the working woman and, even more, the working mother; and

(3) restrictions on higher education for women

Such pressures are so pervasive that they are typically perceived as "natural," and not simply cultural prescriptions. They are so powerful that even the current movement for women's liberation has hardly questioned motherhood as one of the goals for the modern woman. (Commission on Population Growth and the American Future 1972, pp. 90-91)

It is hoped that internalizing the concepts developed in this chapter will encourage young women and men to seek a greater range of choice. Both women and men must be free to develop as individuals, to break out of the molds of sex stereotypes.

Level I

Concept 1
Only recently, and only in the more modern societies, has the death rate become low enough to allow a smaller average family size.

Concept 2
Until recently in most societies, childbearing and child rearing were considered women's primary reason for being.

Concept 3
The American woman should be able to choose from a variety of roles and should not feel obligated to those of wife and mother.

Concept 4
Census and survey data show a relationship between women's labor force participation and their fertility.

Concept 5
Society's definition of how women should gain fulfillment is changing, and with it the ways young women can plan for their futures.

Level II

Concept 1
Life expectancy has increased dramatically in most societies, lengthening the span of time available for the fulfillment of many family functions.

Concept 2
The significant changes in age at marriage and in the spacing of births have pronounced implications on both a societal level (population growth) and an individual level (family well-being).

Concept 3
The timing of higher education, beginning of career, marriage, and birth of first and last child can be advantageously changed by young men and women.

Level I

Concept 1

Only recently, and only in the more modern societies, has the infant death rate become low enough to allow a smaller average family size.

Discussion

In earlier times, when health and medical conditions were crude, many of the infants a woman gave birth to died within a year. If a couple wanted to have two or three children grow up to help hunt for food or farm the land someday, the wife would have to give birth many times, realizing that she would lose a number of her babies.

Today, in most parts of the world, things have changed. Particularly in the more modern societies, where women are well nourished and can get good and inexpensive prenatal care, almost all babies survive birth and live through the relatively more dangerous first year of life. Note the declining infant mortality rate over the past 30 years in the United States. (The infant mortality rate is the number of deaths before age one per 1,000 live births.)

1940—47 per 1,000
1950—29 per 1,000
1960—26 per 1,000
1970—20 per 1,000

This improved rate of survival means that a family still desiring two or three healthy children to survive to adult years will want to limit the number of times the mother gives birth. On the societal level, the fact that fewer babies are dying means that the society will survive and grow even though each of its families has fewer babies.

Activities

1. Have students do a one-page research paper on the Hutterite community in the U.S., to become aware of the physiological reproductive potential of American women. Information is available in most encyclopedias and in the first three sources listed in the References.

2. Invite a nutritionist or nurse to explain the environmental and medical factors responsible for the major decline in infant mortality rates. Encourage students to inquire about the importance of socio-economic factors and to ask why the United States still has such a high infant mortality rate compared to other modern nations. (See #2.)

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TABLE 2

Infant Deaths per 1,000 Live Births
(Deaths under one year)

Rank	*Country*	*Year*	*Rate*
1	[illegible]	1971	11.1
2	Sweden	1969	11.7
3	Finland	1971	11.8
4	Japan	1970	13.1
5	Iceland	1970	13.3
6	Norway	1969	13.8
7	France	1971	14.4
8	Denmark	1969	14.8
9	Switzerland	1970	15.1
10	New Zealand	1970	16.7
11	Australia	1970	17.9
12	United Kingdom	1971	18.0
13	East Germany	1970	18.8
14	Ireland	1970	19.2
15	Canada	1969	19.3
16	**United States**	**1970**	**19.8**
17	Belgium	1970	20.5
18	Czechoslovakia	1970	22.1
[illegible]	Federal Republic of Germany	1970	23.6

Source: Statistical Office of the United Nations. *Population and Vital Statistics Report: Data available as of 1 April 1972*. New York: United Nations, 1972.

Concept 2

Until recently in most societies, childbearing and child rearing were considered women's primary reason for being.

Discussion

The inventions of the industrial revolution released more and more men from the daily grind of hunting, fishing, and farming, but these inventions did nothing to change the routine lives of most women, whose primary reason for being was still considered to be the bearing and rearing of children. Girls were taught to expect fulfillment in motherhood. Very few were able to look beyond this maternally defined way of life.

While it did not change the cultural definitions of fulfillment for women, the industrial revolution did bring about other changes. Medical and public health measures reduced the infant mortality rate and lengthened the life span. Meanwhile, changes in economic organization almost eliminated the family as an economic unit. Primarily in response to these social and economic changes, women began to work outside the home. But thoughts of self-fulfillment—always an aristocratic ideal—were probably far from their minds. They were still conditioned to believe that their real fulfillment would come in their *private* lives, as nurturing mothers and supporting wives.

How could it? Modern culture encourages husbands to seek stimulation and fulfillment through their work roles and public lives and encourages children to seek the same through their school and play activities with friends their own age. But social and technological changes have both liberated and deprived wives and mothers of their traditional time-consuming roles in the home. Even full-time child care demands only five or six years per child.

More and more married women are now entering the American work force. In 1940, 13.8 percent of the married women living with their husbands worked. By 1971, that proportion had grown to 41 percent. (U.S. Department of Labor 1972, p.3) The number of working mothers, particularly those with children under the age of ten, is also growing.

Is today's average working woman finding fulfillment in her work role? It seems unlikely. The jobs most women hold are not very stimulating or demanding of creative energies. The three occupational groups in which women held the majority of positions in 1968 were private household workers (98 percent), other service workers (57 percent), and clerical workers (73 percent). (U.S. Department of Labor 1969, p. 94)

So the potential of women, who after all make up half of the nation's specially talented citizens, continues to go untapped. There is no longer any excuse for committing all our womanpower either to the production and care of children or to the roles designed to make women secondary and supportive to men.

Activities

1. Encourage students in half the class to search through old magazines and textbooks for examples of the narrowness of the socially defined roles for women—e.g., having babies and being good housewives. Ask the other half to search for similar examples in current literature. Schedule a class presentation and discussion of the findings.

2. Ask each female student to list, overnight, the career possibilities she is considering and to explain briefly the personal advantages and disadvantages of each. Have each student share her ideas in class. Tabulate on the board the types of jobs being considered and how many students plan to start their careers before marriage, before having children, while their children are young, or only after their children have moved away from home.

3. Suggest that each female class member interview a male student or friend, asking the same kinds of questions as in #2 above. Later ask each student to report the answers she got, making sure to tabulate them in the same way as was done for the class members. Now compare the answers. Encourage class discussion of the reasons for various differences, their historical basis, and particular patterns of American society that might cause some of them.

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Concept 3

The American woman should be able to choose from a wide variety of roles and should not feel obligated to those of wife and mother.

Discussion

Not all cultures limit women's roles so narrowly as ours does. In Soviet society, for example, social pressure to enter the work force is put on everyone who is able to work, regardless of gender. For mothers to work is considered good for the country, good for the mothers, and good for the children.

In the United States the married but childless woman is feeling less and less social pressure to stay home (although our value system still fails to give support to the married woman who chooses a full-time professional career). But it is when she combines the roles of working woman, wife, and *mother* that the American woman feels real strain, frustration, and often guilt. She is considered "selfish" if she leaves her children during the day to work for her own enjoyment and intellectual fulfillment.

Even those mothers for whom working is an economic necessity often feel guilty for enjoying their occupations. Guilty of what? Neglecting their children? Psychological studies have shown that having a working mother does not affect children in any negative or undesirable ways. Still the working mother feels guilt for having "failed" in her most "important" role. Meanwhile many young women at home, bored with their limited surroundings, attempt to fill their lives by having another baby.

One indication that American women still seek their primary fulfillment through marriage and motherhood, despite the fact that more and more of them are working, is their average age at marriage, which is one of the lowest in the Western world. Early marriage usually means early motherhood, which in turn means less time and fewer resources for higher education and advanced training. This early marriage pattern makes large-scale participation in the professions by women extremely unlikely.

Activities

1. Suggest that students identify and invite two young professional career women, one with a family and one without, to lead a panel discussion about the conflicts they confronted in training for, entering, and continuing with a career. Encourage the women to discuss the decisions they made about marriage, family and household responsibilities, training, etc., as they affected and continue to affect their working roles. Encourage students to ask questions about the kinds of pressure the women have faced from family and friends concerning their traditional responsibilities to marry and raise a family.

2. If possible, ask a young mother who married while still in high school to describe to the class any difficulties she experienced in finishing school, planning for college, or training for a career. Encourage students to ask practical questions as to financial difficulties, pregnancy, and the strain of keeping house, babysitting, studying, and holding a job. Discuss the "trap" of early marriage and/or pregnancy.

3. A study by Jessie Bernard has shown that women who earned advanced degrees during the baby-boom decade (1945-55) had a lower than average fertility rate. Ask students to write a one-page explanation of the possible reasons for this difference.

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Concept 4

Census and survey data show a relationship between women's labor force participation and their fertility.

Discussion

In almost all societies studied an association has been found to exist between women's fertility rates and their participation in the work force. This relationship is well documented in the United States, Germany, Sweden, and the Soviet Union.

In the Soviet Union, where women are encouraged to enter professional careers, completed urban families have an average of one child and completed rural families an average of 1.25 children (Mandel 1970). In Sweden, where more and more women are employed, the average completed family size is barely over two children (Leyon 1968). In the United States we find that a wife's work experience is related not only to actual family size, but also to what a couple expresses as its ideal family size. Several American studies have discovered that the longer a wife has worked since marriage (holding constant age of wife or length of marriage or both), the smaller the family she and her husband expect to have. The difference in desired or expected family size between wives who have never worked outside the home and those who have worked five years or more is about one child. (Blake 1965, p. 64)

It is not clear, however, from any of the studies done so far whether the small family ideal is due solely to the wife's labor force participation or whether the desire for a small family precedes either family experience or work experience.

Activities

1. Ask students to discuss why there might often be differences between what couples see as an "ideal" family size and the family size they themselves expect to have. Discuss social and economic pressures that might come into play.

2. Take an informal class survey of how many children each student expects to have. Ask also how many intend to have a career outside the home for most of their lives. Ask two class representatives to visit a high school home economics or family life class in order to survey older students on the same questions. When results of both surveys are organized in visual form, have the class discuss any relationships they see between plans to work and plans for family size. Inform students of the relationship found in many societies between fertility levels and participation of women in the labor force. Emphasize the findings of Blake.

3. Invite a student or teacher from a nearby high school or college sociology class to lead a discussion about the possible cause-effect relationship among the variables of family size, advanced education, and work force participation by women.

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Concept 5

Society's definition of how women should gain fulfillment is changing, and with it the ways young women can plan for their futures.

Discussion

A woman feels strong pressure to fit society's definitions of what it means to be feminine, a loving wife, a responsible mother, etc. This pressure affects the choices she makes from early girlhood on, and it has particular consequences for the sex division of labor. If women work only when they are forced to by financial burdens, they will not plan ahead for training, will not orient their lives toward a career; instead, they will probably drift into jobs that are easy to find and require little advance preparation.

Because in American culture many occupations are considered "male" and others "female," girls get an idea of what work is "proper" for them at a very early age, and they plan (or do not plan!) accordingly. Work roles are not so narrowly defined in certain other societies. In both Sweden and the Soviet Union, for example, women are encouraged to enter the professions. Note in table 3 (page 38) the great differences among the U.S., the U.S.S.R., and Sweden in the proportion of women in selected professions.

Let's look also at the number of years of schooling American girls receive. Many never make it past high school simply because they are girls; their brothers of equal or lesser ability are urged to go to college. Although there are more girls than boys in high school graduating classes, more men than women graduate from college—a pattern that has not changed since the beginning of this century.

The popular notion is that more and more women are going on for professional training these days, but the statistics tell a different story. Women actually earned a *higher* proportion of the doctorates granted in the United States in 1930 (15.4 percent) than in 1967 (11.9 percent). (U.S. Department of Labor 1969, p. 191) The story is similar for bachelor's and master's degrees.

The college dropout picture also gives us clues to the low percentage of American women in professional jobs. The dropout rate is the same for both sexes: four out of every ten who enter. The reasons for dropping out are quite different, however. The men leave college because of academic or personal adjustment problems, while the women usually leave because of marriage. On the graduate level, women do drop out more frequently than men. And, of course, many able women never reach this level in the first place.

All arrows direct the American girl toward marriage and not toward professional advancement. The main message she receives, in obvious as well as subtle forms, is that in order to "be a woman" she should seek marriage and children.

> There is probably no society in the world which does not stress marriage as the primary objective of the overwhelming majority of its young women. Men face the marriage mandate, too, but though marriage is implicitly emphasized as a requisite for manhood, marriage itself is not seen as a goal, a limiting factor, or a state excluding the man's other role commitments. Men marry and seek happiness by challenging the world; for women, however, it is enough to marry and to live happily ever after. (Epstein 1971, p. 62)

Half of our capable and creative people are women. They have as much potential for challenging the world as men do, but this potential is not developed in the haven of early marriage and motherhood. Young women can plan and prepare for fulfillment in many other spheres, but they must start early.

Activities

1. Have the class invite a woman graduate student (in law, medicine, psychology, or some other field) to discuss the development of her career. Encourage questions about how early she started planning her course work and employment experience. Ask about the ratio of men to women in her professional school or department and the kinds of pressures and discrimination she experiences in her academic and professional roles.

TABLE 3

Women in Selected Professions, by Country

(Occupation Percentage)

	Lawyers	*Physicians*	*Dentists*	*Judges*	*Engineers*
U.S.	3.5%	6.5%	2.1%	2.0%	1.2%
U.S.S.R.	36.0	75.0	83.0	30.0-40	28.0
Sweden	6.1	15.4	24.4	6.7	1.3

Sources:

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Swedish figures. Rossel, James. *Women in Sweden.* Stockholm: The Swedish Institute. (Based on 1960 census.)

2. Encourage a few students to do an extracurricular investigation of the career counseling offices at their school and at the nearest senior high school. What differences are apparent in the directions girl and boy students are encouraged to take? Ask the investigators to report their findings to the class for discussion.

3. Ask each student to find an article in a magazine, newspaper, or book on the roles of women and/or the women's liberation movement, and to take one argument or case from the article to defend or repudiate on the basis of what she knows and feels personally or has read or heard from others.

4. Have the class organize and sponsor a mother-daughter symposium on the potential of women. Encourage the planners to invite all girl students in the school and their mothers to attend this evening event. Allow students to plan the program, but give direction concerning resource people and topics to be covered. Encourage mother-daughter teams to address a variety of changing women's roles: woman as creator, woman as consumer, woman as companion, woman as problem solver. If possible, have a sociologist or psychologist from a nearby college or university speak on the strain more and more women are experiencing today because of role conflicts.

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For Further Classroom Use

See resources listed on page 43.

Level II

Concept 1

Life expectancy has increased dramatically in most societies, lengthening the span of time available for the fulfillment of many family functions.

Discussion

Only recently in human history have we been able to exercise any important control over our mortality. Slowly declining death rates have been well documented in Western Europe and North America for several hundred years, but in the developing countries, where a large share of the world's population is to be found, the decline has been more recent and more spectacular.

In times past, the high probability that one, if not both, parents would die before their children reached maturity had a very significant effect on family institutions. The survival of the society depended upon early marriages and early and numerous conceptions within those marriages. Today, in contrast, most people born in the more advanced societies can look forward to reaching virtually all the important stages in the life cycle. They can make plans for their entire education and work life with little fear of not being able to carry them out.

The intriguing questions now are, When and how will the family institution that evolved over many centuries in response to high mortality conditions change in response to the greatly decreased risk of early death? What are the possible effects of longer life expectancy on the spacing of key events in the family life cycle? Most important events and stages of life—education, beginning of work career, age at marriage, age at birth of first and last child—are associated with given ages. These associations can change, however. More important, such changes can have marked repercussions on the societal as well as the inidvidual level.

Let's examine the trend of age at first marriage during the period when life expectancy was increasing significantly in the United States. Between 1890 and 1960, life expectancy at age 20 increased 13 years for men and 11 years for women (Jacobson 1964, p. 36). It would seem reasonable that the spacing of key events in the typical lifetime would also have changed, to take advantage of the longer time span available. Specifically, we might expect that age at first marriage would have risen. But exactly the opposite happened. Between 1890 and 1960 the median age at first marriage *declined* about four years for men and about two years for women (Rele 1965, p. 220).

Activities

1. Have students do some research into their own family histories in an attempt to find our how many years their great-great-grandparents lived. Allow three or four weeks for this assignment so that genealogies can be located. Schedule a class period for reporting and averaging the ages at death. Compare this average with the average life expectancy of U.S. citizens born in 1900, which was 47 (46 for men and 48 for women).

Ask a team of two students to phone or visit a local life insurance company to find out the average life expectancy of people their own age. Have them report these figures back to the class to show the dramatic increase in life expectancy over the last seventy-odd years.

2. Building on the findings of activity #1, lead a class discussion of the possible effects increased life expectancy could have on family formation. Consider age at several stages of the life cycle: education, beginning of work career, marriage, birth of first and last child.

References

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TABLE 4

Effect of Median Age at Childbearing on Future Population
(Based on Series D Census Projections)

Median Age of Mother	*Fertility Assumption*	*Population in Year 2000*
27.2 years	2.45 children per woman	280,740,000
25.1 years	2.45 children per woman	288,293,000

Source:
U.S. Bureau of the Census. "Projections of the Population of the United States, by Age and Sex: 1970 to 2020." *Current Population Reports.* Series P-25, Nos. 448 and 470. Washington, D.C.: Government Printing Office, 1970, 1971.

Concept 2

The significant changes in age at marriage and in the spacing of births have had pronounced repercussions on both a societal level (population growth) and an individual level (family well-being).

Discussion

Not only has age at first marriage declined, especially since World War II,* but family formation patterns have also changed. For women, the interval between first marriage and birth of the first child has declined slightly, and the time intervals between subsequent births have been reduced. Surprisingly enough, these slight changes, which have allowed most women to complete their childbearing period by the age of 30, have had quite pronounced effects on population growth in the United States. The short-term effect has been to increase today's population by several million over what it would have been if the timing and spacing of births had remained unchanged. The long-term effect has been to decrease the span of a generation.

What are the effects of these timing changes on family well-being? Age at first marriage is closely related to the stability of the marriage, and there is no question about the costs of unsuccessful early marriage to the couples involved. Other effects on the family cycle have been pointed out by Freedman and Coombs. Their Detroit sample survey of white women living with their husbands revealed a "strong and consistent" relationship between timing of births and economic position (measured by current income or accumulated property). The sizable minority (20 percent) of couples in which the wife was premaritally pregnant were "particularly disadvantaged economically," partly because they had the rest of their children more quickly than other couples.

The lowering of age at first marriage has worked to compress within the brief time span of the early twenties many of the most important stages of the life cycle: advanced education, marriage, beginning of work career, and family formation. In short, we have succeeded in pushing back the threat of death but have not even begun to use our increased longevity to our own or our society's advantage.

* There has been a slight rise (less than one year) since the early 1960's. (National Center for Health Statistics 1971, p. 1-13)

Activities

1. Invite a young mother who married while still in high school to discuss with the class the difficulties she and her husband may have had in finishing school, training for career, providing for children, pursuing special interests, etc.

2. Invite a demographer (college student or professor) to acquaint students with the concept of "generation span." Ask him or her to explain thoroughly the long-term effects a reduction of generation span has on population growth. In preparation for this explanation, ask students to be familiar with table 4 (page 40).

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Concept 3

The timing of higher education, beginning of career, marriage, and birth of first and last child can be advantageously changed by young men and women.

Discussion

Would the quality of life for families and societies be improved by a wider spacing of our key life stages? Particularly in the United States and other modern nations, the recent squeezing of advanced education, early working years, marriage, and family formation into the age period of the early twenties has few advantages for the individual, the couple, or the society.

Couples who have their children very soon after marriage quickly face great economic pressure, particularly if they have married young. Pursuing their educations, preparing for and committing themselves to their careers, and making sacrifices for future gains all become quite difficult once there are children to be considered. The young wife often finds herself trapped in the repetitive tasks and responsibilities of housekeeping and child rearing during the years when her opportunities for higher education and career training are best. The pregnant high school or college dropout, even if happily married, is handicapped in ways she cannot easily change.

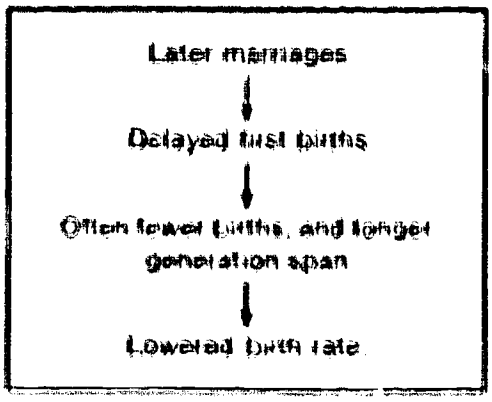
There are demographic as well as personal advantages to raising the average age at marriage by several years and to planning longer intervals between births. Even without any reduction in average completed family size, these two changes would greatly reduce birth rates. Raising the age at marriage has the immediate effect of delaying first births that much longer, and the long-term effect of increasing the span of a generation.

At a time when most of the poor countries are trying to slow their rate of population growth, these changes could make quite a difference, especially if combined with reductions in completed family size. For women in developing societies, the burdens of dependency and poor health brought on by early and frequent childbearing could be greatly lessened by a change in spacing. A later age at marriage would also free more women to enter the labor force, probably resulting in lowered fertility.

Activities

1. Open the class for a discussion of "key life stages" in our society and others. Ask students to list the stages and then to order them in the sequence they consider best for their own and their family's future. Discuss the advantages and disadvantages of overlap.

2. Discuss what demographers mean by the "reproductive period" of a woman's life (usually considered to be between the ages of 15 and 44). Decide whether this is a more physiologically than socially defined period in our society and in others. Discuss the social effects a later age at marriage has on this reproductive period. (It shortens it, of course, and it also means that first births can be delayed that much longer.) Try to see how a higher average age at marriage could actually reduce a society's birth rate.



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Film

Modern Women: The Uneasy Life. 60 min., 16 mm, b & w. Indiana University, Audio-Visual Center, Bloomington, Ind. 47401. 1967. *Focuses on problems faced by women who are familiar with and prefer life outside the home. Highlights the value conflict experienced by educated women who attempt to combine a career with the traditional homemaker role. Focuses on different teaching approaches with young girls and what kinds of behavior the various approaches reinforce.*

Health

Introduction

Health, food supply, and population growth are related in complex ways, as are health, deteriorating and crowded living space, and population density. In both cases, population growth is a variable that intensifies the problems caused by our patterns of social and economic organization.

As René Dubos leads us to see, we human beings—in a state of mental as well as physical health—are uniquely creative and adaptable animals. The danger is that in adapting to our increasingly complex and crowded environment, we may lose our most human social and mental characteristics. The implications of our adaptability are an important thread in the discussion of the following concepts.

Level I

Concept 1
Today there is a new relationship between health, wealth, and population: "The richer a society aspires to become, the fewer additional people it can support in conditions of freedom and health."

Concept 2
A healthy life in a more crowded world will depend on our ability to make continual changes in our relationship with the environment.

Level II

Concept 1
The status of health or disease are measures of the success or failure of human efforts to adapt to environmental challenges.

Concept 2
The problem of crowding is more complex in human than in animal populations, because it is largely determined by social and cultural conditions.

Concept 3
Limiting the number of persons in an area makes it possible to use the available social and physical resources in such a way as to more easily maintain a satisfactory state of health.

Level I

Concept 1

Today there is a new relationship between health, wealth, and population: "The richer a society aspires to become, the fewer additional people it can support in conditions of freedom and health." (*Population Bulletin* June 1970, p. 2)

Discussion

We must stop to consider the ultimate environmental and health consequences of our efforts to narrow the economic gap between nations while both U.S. consumption levels and world population continue to increase. With a 1972 world population of 3.8 billion and an annual growth rate of about 2 percent, we can expect that by the end of this century 6 to 7 billion people will be alive and dependent upon the globe's resources for food and a decent standard of living. But even now, two-thirds of the world's people are ill-nourished. "Hundreds of millions of people are not adequately fed even by the dietary standards of hogs currently being fattened for the U.S. market." (Ogburn 1970, p. 9)

Where is the food of the future to come from? It has been estimated that if all the potentially arable land in the world were cultivated to a European production level, 3.7 billion people could enjoy a diet similar to that of most Europeans. (Brown, *et al.*, 1957, p. 67) But world population is already 3.8 billion. Can the West (the United States and Europe, primarily), which already imports more proteins than it exports, really help the rest of the world reach Western nutrition standards? Is there any hope of meeting the nutritional needs of all the world's peoples in the future?

Let's consider the four sources of food often relied upon by those who believe technology can solve the problem:

- The dream of billions of *fertile new acres* ignores the fact that a third of the earth's total land area is already tilled or in pasture; a fifth of the total area is covered with ice and snow; another two-fifths is in the form of mountains, unproductive plateaus, deserts, and arid zones. Only 950 million new cultivatable acres remain. Food scientist Georg Borgstrom calculates that we need to use 125 million of these acres each year to meet just the essential nutritional needs of the annual population increase of 70 million people. (Borgstrom 1969, p. 300)
- What about *food from the sea and from fresh water fisheries*? The ocean's resources are great, but the supply is hardly inexhaustible. Our annual fish catch rose from 5 million metric tons in 1900 to 64 million in the 1960's. And what about the supply of food for the fish? The plankton at the bottom of the food chain require water rich in mineral nutrients. Because of the energy losses at each link in the food chain, it takes about 100,000 pounds of algae to produce one pound of cod. (See figure 6, page 46.)
- Can we depend on *chemically synthesized food*? Major petroleum companies are expanding their efforts to synthesize fats from coal. The cost would be extremely high, however, and the supply of petroleum (one of our limited fossil fuels) would not meet the world's food requirements.
- Increased food supplies from *high-yield crops* can only buy us time. The fruits of what is now called the "green revolution" require high levels of fertilization and irrigation, both of which contribute to imbalances in local and distant environments. Fertilizers require such an abundance of water that long before they could be applied universally, the water supply would be exhausted. Water is already being withdrawn from all the inhabited continents faster than it is being returned by precipitation; the net loss grows each year.

To provide barely adequate nourishment for the billions of humans we shall have in the year 2000 and beyond, it appears that we must break radically out of the hydrological pattern that has supported man throughout his history. (Ogburn 1970, p. 16)

There is no one solution. All nations must tackle the problem of population growth. Those with enough wealth to keep their own people nourished must more carefully consider the crucial relationship now existing between wealth, health, and numbers of people. The industrialized nations, especially the United States, cannot continue consuming natural resources at present levels without jeopardizing the well-being of other societies as well as of their own future generations.

Activities

1. Encourage the student council to sponsor a "Responsible Consumer Week." It might begin with an assembly illustrating (through skits, posters, songs, etc.) the wide discrepancy between the consumption patterns of affluent and poor peoples. Interested students can draw up and distribute lists of responsible consumer practices (e.g., use of low-phosphate soaps, returnable bottles, recycled newspapers; limited use of electrical gadgets).

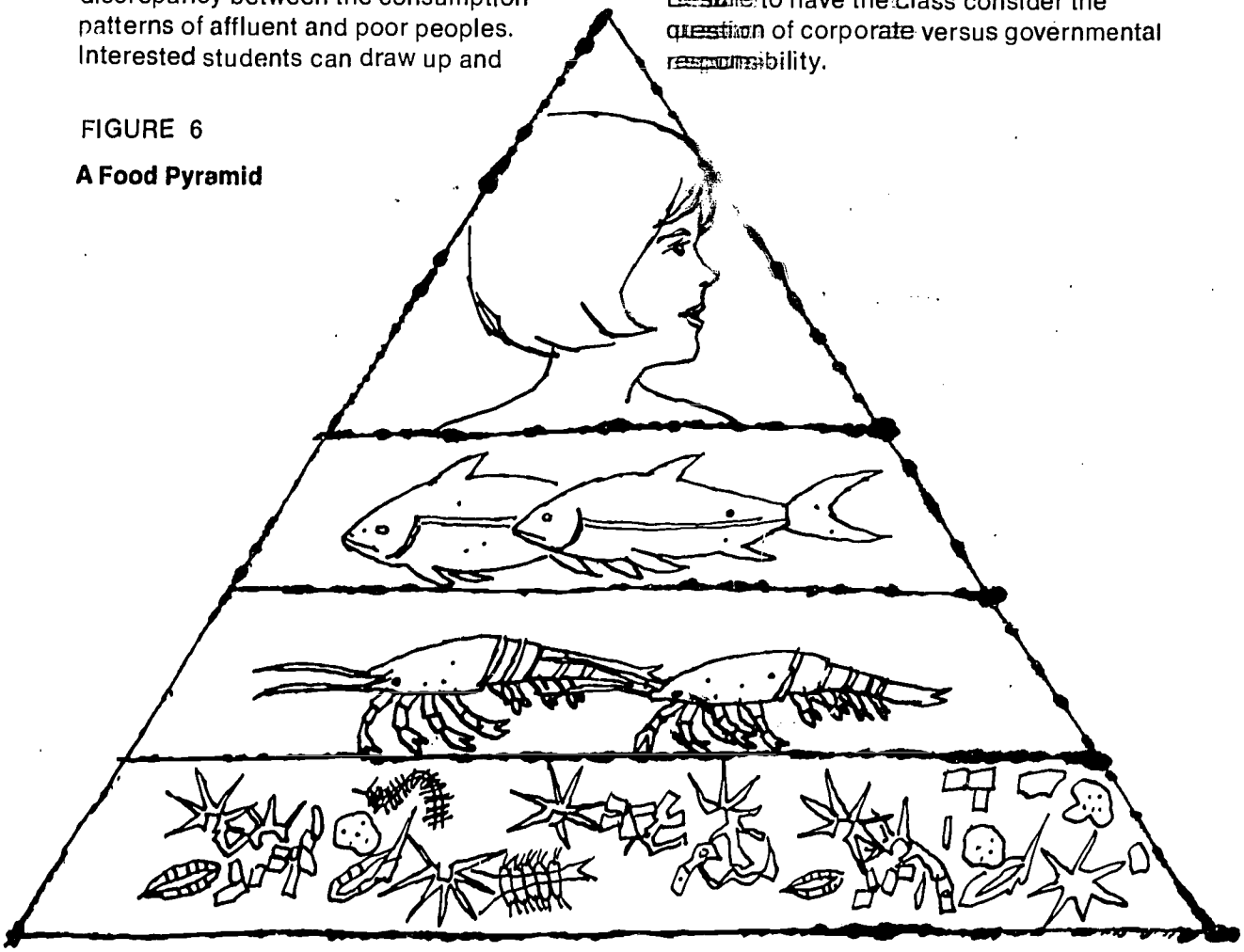
2. With the help of a college instructor or student of economics, study the economics of recycling. Focus class discussion around the following statement:

> It might dispose the industrialized nations, and above all the United States, to be less prodigal in their consumption of resources and to salvage more of their wastes. . . . We are fouling our waterways with organic wastes that might replace the nutrients which we extract from our farmlands. Nearly all the wastes of our industrial civilization, the effluents of factories, the bottles, papers, cans and carbodies, are resources we strew across the landscape at the same time that we mine the earth to obtain their constituents. This is currently an economical practice, but it is madness nonetheless. (Ogburn 1970, p. 32)

Be sure to have the class consider the question of corporate versus governmental responsibility.

FIGURE 6

A Food Pyramid



Source:
Based on a drawing in Pringle, Laurence. *One Earth, Many People.* New York: The Macmillan Company, 1971. p. 29.

3. Have students make impromptu speeches on such topics as "Rent it, return it, recycle it, reuse it" and "Buy it, burn it, bury it."

4. Discuss what is meant by limited resources and their effect on food production.

Land: Total square feet or acres on earth; amount of arable land; factors limiting the use and productivity of arable land (housing demands, highway development, fertilization and irrigation requirements).

Water: Net loss in water cycle each year (precipitation minus withdrawal); polluted waterways; demands for drinking, irrigation, wildlife, marine life, fertilizer use.

Air: Polluted air stopping photosynthesis, destroying plants and trees.

5. Invite an agriculture teacher or expert to discuss the increased crop yields resulting from use of DDT and other pesticides and fertilizers. Ask students to follow up the discussion with research and a short paper on the environmental dangers of pesticides and fertilizers for animal, marine, and human life.

6. Early in the term have students read Rachel Carson's *Silent Spring* (1962). Schedule a class discussion of its implications.

7. Ask four students to lead a panel discussion attempting to answer the following questions: What is a food surplus? Do we have any such thing as a food surplus when thousands of people in our own country are malnourished and millions around the globe are seriously undernourished? Why does the U.S. government pay farmers *not* to grow crops?

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Concept 2

A healthy life in a more crowded world will depend upon our ability to make continual changes in our relationship with the environment.

Discussion

Although demographers (students of human population characteristics and changes) disagree on how fast the world's population will grow and when it will reach its peak, all agree at least that the earth will be much more densely populated in coming years than it has been in the past. Throughout most of human history there have been scattered areas of congestion, but now this condition is becoming more widespread.

Concept 1 focused on the problem of how to provide the bare nutritional essentials for growing numbers of people. But even if it becomes possible to feed the 6 to 7 billion world citizens expected at the end of this century, the effects of crowding may still make physical and mental well-being impossible.

What will be some of the consequences of a more crowded world? One, of course, will be that the amount of space per person will decrease. This reduction in "elbow room" will be felt even in the United States, where general living space is still ample.

David Heer's treatment of the *social* effects of high and low population density is relevant to our investigation of the *health* effects, for it is impossible to consider health without considering both physical and social surroundings and their physiological and psychological effects on human beings. Much of the following discussion is taken from Heer (1968, pp. 31-33).

Research on the effects of population density has been carried out chiefly with animals, and the findings cannot be applied directly to human populations. John B. Calhoun, experimenting with laboratory rats, created an environment that provided freedom from predators and an abundant food supply, but increasingly crowded conditions. He found that high densities created mental stress, which in turn caused breakdowns in social and biological functions, including—

- Mothers failing to build nests and to nurse their young.
- Rise in infant mortality.
- Rise in maternal mortality.
- Among males, homosexuality, extreme aggression, cannibalism of the young, and a desire for isolation.

Because humans adapt to changes so readily through social and cultural mechanisms, we are unsure what implications these animal studies have for us. Crowding seems to be a very relative term for human beings: the way we respond to various degrees of density is conditioned by our culture.

Actually, both very low and very high densities pose problems. Because human beings are gregarious animals, a very low population density usually leads to loneliness and sometimes to desperation. A relatively dense population is necessary for the exchange of new and useful ideas and for the functioning of modern specialized institutions and services (schools, commerce, health services, etc.). But with higher and higher densities, more and more pressure is put on these services, and the sheer number of social contacts forced upon us "may cause mental stress to develop, of a type and intensity which may be clearly exemplified by the strain one encounters in driving in the midst of a rush-hour traffic jam." (Heer 1968, p. 32).

As was pointed out in Concept 1, wealth cannot always buy health. There are limitations both on the earth's capacity to provide food and on our ability to function in healthy and human ways when our environment becomes increasingly crowded.

Activities

1. Through class discussion, emphasize how density levels determine the kinds of social contacts we experience most frequently:

High density	*Low density*
Secondary relationships (superficial acquaintances)	Primary relationships (family, friends)
Contacts based on function being served	Contacts not based on functions
Emotionally neutral contacts	Emotionally expressive contacts

Help students see these differences by having them try to explain how they felt when they moved up from their elementary schools to the larger junior high. Did they feel as if they didn't know anyone? As if they were strangers? As if the teachers couldn't care about them or give them individual attention? As if they were somehow less important?

2. Invite a representative of Model Cities or a community health clinic in the inner city to discuss with the class why the crowding common to central city areas is not the sole cause of poor and unhealthy living conditions. Encourage students to ask questions about other factors (political, social, and economic) such as racism, unfair housing policies, and average income.

3. Arrange to have four or five tape recorders available. Divide the class into small groups to (a) identify a stressful situation that city dwellers or commuters are forced to endure regularly, such as the subway crush, the traffic jam, the grocery store line, or the crowded beach, and then (b) interview a person in the midst of or just relieved from that situation, to determine the frustration and physical and mental stress he or she may have experienced. Schedule time for playing back these interviews for the entire class. If possible, bring a psychologist in to react to some of the implications for mental health.

4. In a class discussion, trace the development of specialization and division of labor in human social evolution, focusing on health care as an example. Ask students to list the various types of people who keep them healthy, from dentists through public health officials. Discuss the practical need to live relatively close to a number of other people.

5. Following activity #4, either in the same class session or at the next one, ask an official of the city or county health department to discuss the serious shortage of health manpower in most communities. Too many people are dependent upon the available medical resources, with the result that many poor people go completely without necessary care. Discuss the role growing population plays in intensifying this health problem. Point out that 3.5 million babies will be added to the U.S. population each year during the 1970's.

6. Ask two teams of students to debate the following statement: "Wealth cannot buy health."

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The Mounting Millions. 60 min., 16mm, b&w. Indiana University, Audio-Visual Center, Bloomington, Ind. 47401. 1969. *Focuses on the need for economic and agricultural development and social change in India. Special emphasis on alternative solutions to the severe problem of food production shortages.*

To Each a Rightful Share. 30 min., 16mm, b & w. McGraw-Hill Film Preview Library, Princeton Rd., Highstown, N.J. 08520. 1961. *Contrasts the "have" and "have-not" nations in the battle for strategic resources. Shows Western man's wasteful use of these resources.*

Life in the Balance. 30 min., 16mm, color. Modern Talking Pictures, 2000 L St., N.W., Washington, D.C. 20036. 1966. *Documents the story of man's race against hunger. Shows patterns of world food shortages and changes in the environment due to increasing population pressure.*

For Your Pleasure. 4 min., 16mm, color. Mass Media Associates, 2116 N. Charles St., Baltimore, Md. 21218. 1971. *Color animation depicting the transformation of a rural scene into a crowded, noisy megalopolis.*

Boomsville. 11 min., 16mm, color. Learning Corporation of America, 711 Fifth Ave., New York, N.Y. 10022. 1969. *Short animated film produced by the National Film Board of Canada, depicting the historical sequences of modern civilization, particularly migration to North America. Little emphasis on population growth, but accurate portrayal of urban growth and related problems.*

Level II

Concept 1

The states of health or disease are measures of the success or failure of human efforts to adapt to environmental challenges.

Discussion

Perfect health is a utopian concept, because human beings will never be perfectly adapted to their environment. Benjamin Franklin's dream of a time when "all diseases may by sure means be prevented or cured, not excepting that of old age, and our lives lengthened at pleasure . . ." has almost come true in several Western countries, thanks in part to social and medical advances. Yet it should be clear that health and happiness have not followed in step with social, economic, and medical progress.
An abundance of material goods and the miracles of modern medicine are not enough to counteract the stresses apparent in man's urban environments.

A paradox in today's health picture is that despite obvious improvements in nutrition, sanitation, and protection against heat, cold, humidity, and physical fatigue, an ever growing percentage of the population needs medical help. While more and more of us are assured of relative safety and comfort, and while we no longer need fear a recurrence of the great plagues of the past, still the need for medical care and hospital facilities is increasing everywhere. It seems that minor infectious processes now cause more health problems than do chronic illnesses. And just at a time when these infectious diseases are on the rise, the declining ratio of doctors and nurses to patients means that the existing medical staff and facilities are in ever greater demand and under ever greater pressure.

So we can no longer assume that further boosts in our living standards will result in health improvements. Even though human beings now seem to be adapting fairly well to pollution, crowding, overabundant diets, monotonous surroundings, and other environmental changes brought about by economic growth, this apparent adaptation may eventually cause considerable damage to human health, both physical and mental. The damage may be so delayed and so indirect that we will not see the cause-effect relationship.

Activity

1. Acquaint students with the classes of disease: acute, chronic, infectious (major and minor), etc. Give some historical perspective on the most prevalent causes of disease over the last several hundred years. Ask the students to hypothesize about the leading causes of disease and death in modern societies, especially the United States. Suggest an informal family and neighborhood survey to determine frequency and types of illness. Give the students a week or so to complete the questioning and to record their findings. Schedule class time for tabulation, summation, and discussion. Have some national statistics available for comparison, and encourage questions about any marked local differences. (Possible explanations for variations can be sought in the physical and social environment: climate, water supply, crowding, diets, occupations, age makeup of community.) If students are inclined, move the discussion into pressures of the physical and social environment that might cause some mental illness as well.

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Concept 2

The problem of crowding is more complex in human than in animal populations, because it is largely determined by social and cultural conditions.

Discussion

Crowding is becoming an increasingly unavoidable part of human life, whether in the congested urban cores or in the vast new suburban housing developments linked by the automobile and the crowded highways. One consequence of the continuing urban and suburban sprawl is that the old health problems of water, food, and air pollution are reappearing everywhere. Even with the physical and economic comfort possible in city environments, good health is not assured.

For centuries we have operated under the widespread assumption that industrialization and urbanization are unavoidable hazards to human health. The popular consciousness contrasts the gray complexion and flabby muscles of the city dweller with the ruddy cheeks and bronzed, muscular body of his country cousin. In reality, however, life in a large and crowded city does not necessarily preclude good health. The most congested and most heavily industrialized cities can provide conditions compatible with a long and healthy life. The Netherlands, the world's most densely populated country, has one of the world's healthiest populations by general medical standards.

Not much is really known about how dense a population would be ideal for the long-run healthy functioning of the human mind and body. Crowding, of course, is a relative term. A setting one person finds crowded and stressful may seem quite comfortable and interesting to another, depending upon his past experience. So the significance of population density must be measured in light of the past experiences of the group concerned. It is these experiences that condition the way the group members respond to their physical and social surroundings. For example, the "proper" distance between persons in a group varies from culture to culture. Many Americans, viewing privacy as a basic right and wide open spaces as a basic good, would find the closely shared existence in Hong Kong's san pan communities distasteful, if not intolerable.

What have we said? That human groups can *adapt over time* to a population density that might once have been harmful to them. The world has become more and more urbanized, and most people now accept the constant contact with hordes of other human beings as a normal part of everyday life. This is not to deny, however, the potential dangers of crowded and polluted environments. Sudden increases in population density can be as dangerous for humans as they are for animals. During the industrial revolution, the lack of sanitation and the crowded conditions in the tenements and factories had harmful effects on the new laborers who had just come from rural areas and were totally unadapted to urban living.

Laboratory studies continue to observe the effects of crowding on animals. In chickens, mice, rats, and moles, crowding causes an enlargement of the adrenal glands and upsets both normal growth and reproductive functions. Scientists studying the epidemiology of "crowd" diseases have found that susceptibility to many noxious influences, including infection, changes with association with other living things.

Because human beings so easily adapt to potentially dangerous conditions, we cannot apply to ourselves the results of experiments with animals. A variety of biological and social adaptations have probably eliminated the immediately dangerous consequences of crowding for us. Keep in mind, however, that this very adaptability allows us to adjust to conditions that may eventually destroy the values most characteristic of human life. Our culture has provided social and medical devices that allow us to survive and reproduce in the midst of conditions that may in the long run rob us of our health and creativity.

TABLE 5

The Urbanizing United States, 1800-1970

Year	Urban Population (Thousands)	%	Rural Population (Thousands)	%	Total Resident Population (Thousands)
1800	322	6	4,986	94	5,308
1830	1,127	9	11,739	91	12,866
1860	6,217	20	25,227	80	31,444
1890	22,106	35	40,841	65	62,947
1920	54,158	51	51,552	49	105,710
1950	96,847	64	54,479	36	151,326
1970	149,325	74	53,887	27	203,212

Note:
The 1970 figures do not total 100 percent, reflecting slight changes in the definitions used in the 1970 census.

Source:
Developed by the Population Reference Bureau, Inc., from data in U.S. Bureau of the Census. *Historical Statistics of the United States, Colonial Times to 1957.* Washington, D.C.: Government Printing Office, 1960. Table updated and reprinted with permission from *Population Bulletin,* April 1970. p. 6.

Activities

1. Reproduce table 5 for class use and discussion. Point out that in 40 years another 100 million people will be using our cities, highways, subways, parks, and beaches.

2. Ask students to get figures (or supply them yourself) from the city or community planning office or the mayor's office on the increase or decrease in local population over the past year. If possible, get projected figures for the coming year. What proportion of the past year's growth, if any, was due to immigration? What proportion was due to natural increase (number of births above number of deaths)?

3. If possible, assign cameras to groups of students and ask them to photograph in their surrounding area (a) an example of how increasing population is being handled (e.g., construction sites, highways, high-rise apartments, new schools, new suburban housing tracts), and (b) an example of crowded conditions (encourage students to use their own criteria).

4. Identify, if possible, a student in the class or school who has recently moved to the city from a rural area, or vice versa. Ask the student to share with the class his or her reactions to the physical and esthetic differences between the two locales. Bring out the concept of adaptation to surroundings by asking students who have lived all their lives in either the city or the country if they feel the same as the newcomer. What role does culture play in helping us adapt to the crowded conditions in our cities?

5. Have the class read Calhoun's article, "Population Density and Social Pathology" (see References). Ask three to five volunteers to lead a panel discussion of this article's implications for human health, if any. Assign one panel member to focus on the role of cultural differences in human reactions to crowding.

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Concept 3

Limiting the number of persons in an area makes it possible to use the available social and physical resources in such a way as to more easily maintain a satisfactory state of health.

Discussion

It has become evident that a rapidly increasing population is a real barrier to improving physical and mental health. Particularly in modern societies, the maintenance of human health depends heavily on *social resources*. These include manpower (doctors, nurses, research scientists), institutions (hospitals, community health clinics, universities), and financial support. When the population of an area grows rapidly, through either immigration or a high rate of natural increase, one result is often a serious shortage of such resources. Health care in the United States is now in a state of crisis "partly because of an absolute deficiency in health manpower plus a 'maldistribution' of the manpower that is available," according to James A. Shannon, M.D., former director of the National Institutes of Health. The manpower shortage makes us increasingly dependent upon doctors educated abroad. Some 20 percent of the new physicians licensed annually to practice in the United States now come from foreign countries.

The 3.5 million new Americans to be born each year during the 1970's will intensify the present crisis in health care, further delaying the day when all sectors of the public will be adequately served. It will be increasingly impossible to "catch up" in the delivery of public services—welfare and education as well as health—as long as our population continues to grow. Even when per capita expenditures for health services and supplies increase drastically (as they did in the U.S. between 1960 and 1967, rising from $140 to $232 per person), they cannot keep pace with the demands of the present population plus those 3.5 million new babies added every year.

Population growth not only hampers efforts to solve many traditional health care problems, but also leads to new health problems every day, as our crowded urban areas place greater and greater demands on available *physical resources*. For example, approximately three-fourths of all U.S. citizens now depend upon community water supply systems. In 1969, 41 percent of these systems did not meet U.S. Public Health Service drinking water standards. (U.S. Department of Health, Education, and Welfare 1970, p. i)

In animal populations it can be taken for granted that territorial patterns of behavior have an adaptive value, if not for the individual members of the group, at least for the population as a whole. By limiting the numbers of animals allowed to breed in a given area, these behavior patterns make it possible for the population to make use of the available resources in such a manner as to maintain a satisfactory state of health. This kind of self-regulation results in the population's short-term and the species' long-term fitness for the environment.

We human beings usually think first of our personal, family, community, and national health. Rarely do we consider what we must do to ensure the survival and health of our whole species as a biological and social unit. The innate biological and social forces that keep most animal populations from multiplying to the point where they run short of food and destroy their habitat no longer operate in us. If the human species is to survive and enjoy a satisfactory state of health, we must rely on personal and societal willingness to regulate population growth.

Activities

1. Ask the class to read and discuss V. C. Wynne-Edwards' article, "Self-Regulating Systems in Populations of Animals" (see References).

2. Invite a representative of your local health department to address the class on the shortage of medical manpower and facilities.

3. In a follow-up discussion, ask students to cite instances when they or a relative received delayed attention or no attention at all from a doctor or dentist, because of waiting lists. Discuss the problem of other nations that need more and more doctors to serve their own less healthy people but are losing many of their trained medical personnel to the U.S., where salaries are higher.

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Films

Boomsville. 11 min., 16mm, color. Learning Corporation of America, 811 Fifth Ave., New York, N.Y. 10022. 1969. *Animated film showing the historical consequences of modern civilization. Little emphasis on population growth but accurate portrayal of urban growth and related problems.*

The Time of Man. 50 min., 16mm, color. Holt, Rinehart and Winston, Inc., Media Sales, 383 Madison Ave., New York, N.Y. 10017. 1971. *Reviews man's evolutionary history and looks at primates in their natural surroundings. Main theme is man's reliance on a supportive ecosystem.*

Pandora's Easy Open Pop Top Box. 18 min., 16mm, color. National Medical Audio-Visual Center (Annex), Station K, Atlanta, Ga. 30324. 1967. *Compares the problems of city life with the quiet of the country; flashbacks between the two environments throughout. No narration.*

For Your Pleasure. 4 min., 16mm, color. Mass Media Associates, 2116 N. Charles St., Baltimore, Md. 21218. 1971. *Animation depicting the transformation of a rural scene into a crowded, noisy megalopolis.*

Multiply and Subdue the Earth. 60 min., 16mm, color. Indiana University, Audio-Visual Center, Bloomington, Ind. 47401. 1967. *Emphasizes land as a precious resource and enjoins ecologically sound land use. Case studies of New Jersey, Minnesota, Tahoe, Baltimore, and Hawaii show the need for taxing and zoning reforms.*

The Crowd. 20 min., 16mm, b & w. Learning Corporation of America, 711 Fifth Ave., New York, N.Y. 10022. 1970. *Visual study of the significant part crowds play in human life. Portrays crowds in parades, dance halls, cathedrals, bullfights, racetracks, and riots. Care must be taken in follow-up discussion because we know so little of the psychology and sociology of crowds.*

Population Ecology. 19 min., 16mm, color. Encyclopaedia Britannica Educational Corporation, Rental Library, 1822 Pickwick Ave., Glenview, Ill. 60025. 1964. *Portrays fluctuation and limitation of population sizes as the environment changes. Explains population growth curve through human history. Concludes that we too must be governed by natural laws.*

Tomorrow's Children. 17 min., 16mm, color. Perennial Education, 1825 Willow Rd., Northfield, Ill. 60093. 1971. *A strong indictment of man's refusal to follow nature's laws of balance. Shows our potential to respond to the physical and psychological needs of our future children through control of our consumption and reproduction patterns.*

History or Social Studies

Introduction

Students of history or the social studies learn a collection of facts about the rise and fall of past and present civilizations. If they can appreciate the interrelationships between a civilization and its environment they may develop an ecological as well as a historical awareness.

An important objective of the unit that follows is to deepen the students' understanding of how current population growth and consumption rates are both depleting natural resources and depriving us of personal freedoms. Students who consider the status of present-day civilization in an ecological-historical perspective are the ones most likely to accept their own personal responsibility to help stop environmental deterioration and to create a high-quality environment for future generations.

Level I

Concept 1

The resources used by a community take on different values as the community grows in size and organizational complexity.

Level II

Concept 1

Throughout history, as the human population has grown in numbers and needs, cultural mechanisms have been devised to increase the carrying capacity of the world ecosystem.

Concept 2

Enlargements in the carrying capacity of the world ecosystem, due primarily to increased use of fossil fuels as a power resource, have made possible an unprecedented increase in population growth in the modern era.

Concept 3

The finite supply of natural resources—especially fossil fuels—is one limit on our ability to go on enlarging the carrying capacity of the world ecosystem.

Concept 4

Current population growth and resource depletion rates are putting pressure on the carrying capacity of the world ecosystem, as seen by the onset of automatic feedback controls.

Level I

Concept 1

The resources used by a community take on different values as the community grows in size and organizational complexity.

Discussion

Land is a good example of a natural resource valued differently by different societies and at different times. The concept of community land took hold in New England, for example, under the influence of religious sects that valued "cooperation"; this value influenced the New England form of government (town meetings) as well as the pattern of land use (common pasture). New England's mountainous topography and rocky soil were other factors contributing to common land use. As community size and organization grew, the "commons" became valuable as a recreation area (public park) rather than as a pasture.

Different land use values have often led to conflicts between communities. The conflict between the European settlers and the First Americans, for example, was caused in part by the contrast between private and community property values.

> To the joint-stock companies of Virginia, intent on commercial profits, and to the colonizing Pilgrims, exclusive possession was the be-all and end-all of landownership. But the Indian's "title," based on the idea that he belonged to the land and was its son, was a charter to use—to use in common with his clan or fellow tribesmen, and not to *use up*. Neither white nor Indian fully grasped the concept of the other. The Indian wanted to live not just in the world, but with it; the white man, who thought in terms of estates and baronies, wanted land he alone could cultivate and use. (Udall 1963, pp. 6-7)

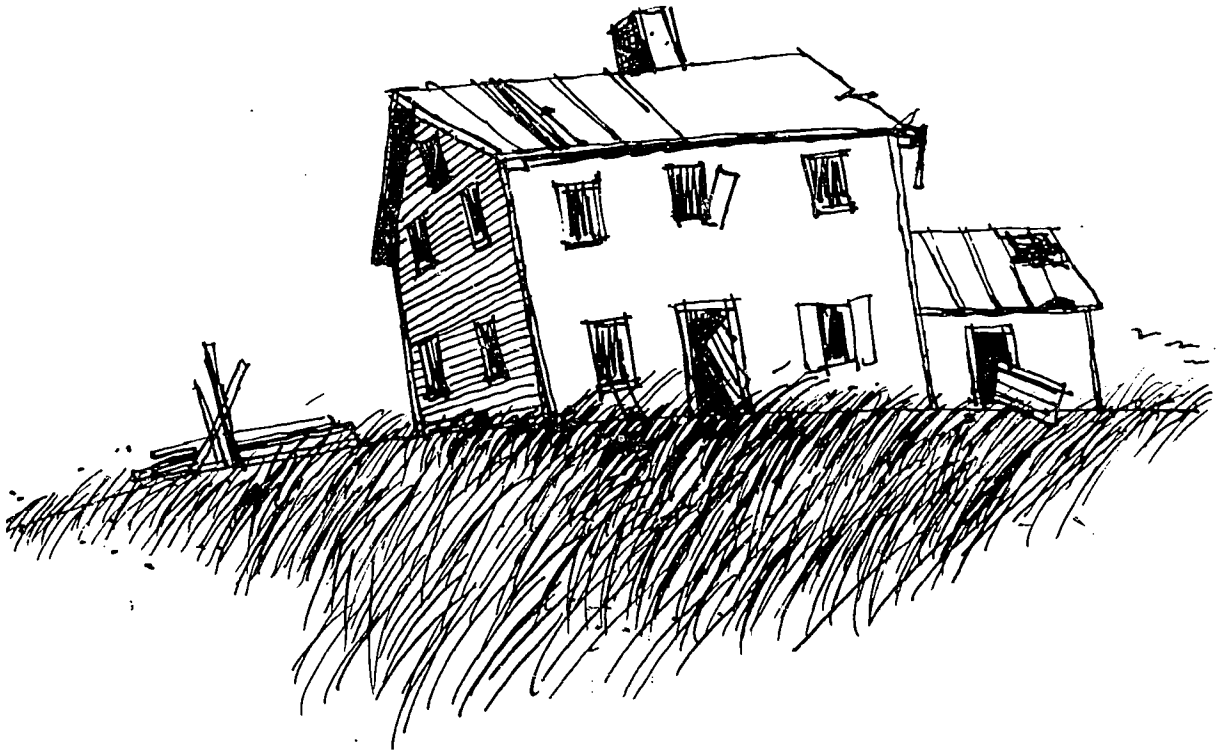
Later, conflict between the values attached to land by ranchers, farmers, and urban recreationists led to the multiple-use philosophy of public land management.

Different land-use patterns were also a factor in the Civil War. The North valued the availability of free land for individual ownership. The South, in contrast, had an economy based on cotton, which could not be grown profitably without large tracts of land and cheap labor (slaves).

Activities

1. Have students list and discuss (a) natural resources valued and used by Western peoples, and (b) changes in the values attached to these resources as communities have grown in size and complexity down through history.
2. Help students trace the history of public park land in their own community. What former uses did it have? (Common pasture? Industrial landfill? Swamp?) Ask the superintendent of a nearby park to visit the class and explain his park's history. Who made the decisions about its present form of use? Who is in charge of protecting the park for this use? Have the students prepare a list of questions to ask the superintendent or to research for themselves, perhaps by talking to long-time residents of the area.
3. On a large U.S. map, have students identify and mark (a) major cities located on rivers or large bodies of water, (b) the major railroad linkages built beginning about 1840, and (c) major cities on the rail network that developed. Discuss the kinds of community and industrial expansion that have occurred at each major connecting point along railroad lines.

In this manner, students can see for themselves how a change from dependency upon water and animals to dependency upon machines (mineral resources) has been a causal factor in the expansion in size and organization level of American communities. As part of this activity, consider taking the class to the local railroad yard. If it is now abandoned, use it as a good example of how land once set aside for one use no longer has value for that use. How can such now wasted space be converted to a valuable use once again? William Whyte's *The Last Landscape* (see References) should be useful as a teacher's guide.



4. Have students collect and compare folklore and folksongs of the American pioneer and the First American that reflect different sets of values toward land and other natural resource use. Suggest that they read Garrett Hardin's article "The Tragedy of the Commons" (see References) and discuss it in class.

5. Have students use the following as the topic sentence for a theme, illustrating it in their own ways based on individual research: "Conflict between values attached to natural resources (especially land) by ranchers, farmers, and urban recreationists led to the need for a multiple-use philosophy of public land management." Ask them to speculate on the continued value of a multiple-use philosophy as the variety and needs of the American people continue to grow.

6. Have students trace the development of certain land-use laws (e.g., the Homestead Acts) in the United States up to the Civil War period, noting the difference between Northern and Southern reactions to these laws.

7. Ask the class to identify a natural resource in the local community around which value conflicts have developed. For example, they might consider a highway location dispute, which pits those who value the land along the proposed route for residential or recreational purposes against those who feel it should be used to accommodate more automobiles. Have students define the conflict and suggest possible solutions, and then publicize the conflict and their own recommendations to the rest of the community.

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For Further Classroom Use

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The Time of Man. 50 min., 16mm, color. Holt, Rinehart and Winston, Media Sales, 383 Madison Ave., New York, N.Y. 10017. 1971. *Reviews human evolutionary history from an anthropological perspective; looks at primates in their natural surroundings; studies primitive populations in Africa and New Guinea to show how man can interact with his environment without causing severe imbalances. Main theme is our reliance on a supportive ecosystem. Concludes with a 10-minute flashback on human intrusions into natural systems over the last 60 years. Stresses population stabilization as a necessary step in regaining balance.*

Level II

Concept 1

Throughout history, as the human population has increased in numbers and needs, cultural mechanisms have been devised to increase the carrying capacity of the world ecosystem.

Discussion

The high school student should already understand what a "culture" is and how different cultures use different natural resources to satisfy the same basic needs. He or she should also be aware that each culture's growth and interaction with others was made possible, in part, by an expansion of its resource base from family to community to other communities, and that resources were often the basis of value conflicts between cultures.

Now the student can focus on the cultural mechanisms people have devised down through history to expand their resource base, i.e., to increase the carrying capacity of the world ecosystem. The first two such mechanisms were very basic:

- When we began to live on permanent sites and to domesticate plants for food, we changed our place in the various food chains from secondary or tertiary consumer to *primary* consumer, increasing our accessibility to the natural resources containing the most energy. It has been estimated that this change increased the carrying capacity of our habitat a hundredfold.
- When we began to find new uses for available resources and to move on to new resources when the old ones were depleted or had become obsolete, we extended the carrying capacity of the ecosystem even farther.

By the beginning of the agro-industrial revolution, Western peoples had devised still another important way to extend the carrying capacity of their habitat: they had begun to use the fossil fuels as "energy subsidies." In 1850, while 90 percent of all energy used for power was derived from sources other than man and animals (e.g., wood, water), only 10 percent of this energy came from fossil fuels. But reliance on fossil fuels has been increasing immensely ever since. For example, the production of crude oil has risen an average of 6.9 percent each year since 1890. (Watt 1970, p. 8) The institutionalized application of labor and capital on fossil fuels as a power resource has become the chief modern cultural mechanism for increasing the carrying capacity of the world ecosystem to support growing numbers of people and needs.

Activities

1. On a large map of the United States, have students mark with one color regions that were settled early due to local availability of agriculturally useful resources to support small clusters of pioneer families, and with another color regions that became prosperous during the transition to an industrially based economy. What systems of resource use were devised that made possible the growth of special industries and populations in urban centers?

2. To increase students' awareness of the cultural mechanisms devised by their own community to increase its carrying capacity, tour a local factory and/or invite a local industrial representative into the classroom to talk about the history of his or her company: how it was established, what community resources attracted it, how it increases the community's carrying capacity by creating more power, more

jobs, more taxable income, more services, etc.

3. Tour a local museum, historical society, or historic landmark that describes the history of the community, and/or invite to the classroom a representative from one of these places to discuss the community's growth as it relates to expansion in numbers and kinds of resources used.

4. Ask interested students to write themes on how the use of fossil fuel–based technology has increased the carrying capacity of their own community. Have them share their theme ideas formally or informally with other members of the class. Have the class as a whole draw general conclusions about how fossil fuel–based technology has increased the carrying capacity of other regions of the United States and other areas of the world.

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Concept 2

Enlargements in the carrying capacity of the world ecosystem, due primarily to increased use of fossil fuels as a power resource, have made possible an unprecedented increase in population growth in the modern era.

Discussion

It took from the dawn of civilization until the beginning of the modern era (1650) for the world population to reach 500 million. Then, between 1650 and 1965, the population skyrocketed to over 3 billion—a better than sixfold increase! To better appreciate the explosive nature of such a sudden rapid increase in population, imagine man's total time on earth as if compressed into one 24-hour day; the modern era would occupy less than one minute. "Yet, this briefest period of human existence has witnessed the greatest increase in numbers." (Stockwell 1968, p. 171)

The modern era's explosive population growth is exemplified in the United States. The first federal census (1790) reported fewer than 4 million people here; today there are over 200 million of us—a better than fiftyfold increase in less than two centuries. (See figure 7, page 66.)

There were two important causes for this dramatic growth. One was the large number of immigrants to the United States. The other was the relatively sudden change from a pattern of high birth rates and high death rates to one of high birth rates and *low* death rates. (For further details on this "demographic gap," see pages 10-13.)

The lowering of the death rate was due not only to advances in public health services but also to the application of fossil fuel–based technology to agriculture, sanitation, transportation, and communication systems. These technological advances, which came first, increased the physical carrying capacity of the ecosystem. Without them, the system would have been unable to support the increased number of people that resulted from such subsequent public health breakthroughs as immunization and antibiotics.

Activities

1. The United States is using up natural resource reserves faster than any other country. Between 1900 and 1956, the amount of raw materials it used increased fivefold. Of the 3 billion tons now used each year, more than 50 percent are minerals used by industry. One-third of these minerals are found in the U.S. (coal, sulphur, crushed stone), one-third are partially found in the U.S. (iron ore, aluminum, zinc, copper), and one-third are totally imported (nickel, chromium, asbestos).

Other resource use has also increased tremendously. For example, the U.S. now imports 23 percent of the iron it uses and expects to be importing one-third by 1975. The U.S. demand for crude oil tripled between 1925 and 1950 and is expected to double every 10 years in the foreseeable future.

- How does the increased rate of use of minerals by industry reflect an increased reliance on fossil fuel technology?

- What happened to the size of the U.S. population during the 1900-1956 period when resource consumption was increasing so greatly? How does the rate of population growth during this period compare to that of earlier periods in American history?

- In what ways does the industrial use of minerals in a fossil fuel–based system of technology increase the carrying capacity of the U.S. over time?

Let students answer these questions individually through research and/or guided reading. Then have a discussion or debate of different answers.

2. Ask students to list the kinds of goods and services produced by the U.S. as a

whole and by their own community over time. Does each new good or service reflect a greater number of people and/or a heavier reliance on fossil fuel technology?

3. The U.S. consumes 50 percent of the raw materials used each year. Divide the class into three teams to research and report on the extent to which (a) population growth, (b) population concentration in technologically specialized regions, and (c) increase in per capita consumption rates have contributed to this situation. Then ask the class as a whole to discuss what will happen if current rates of population growth, concentration, and consumption continue much longer.

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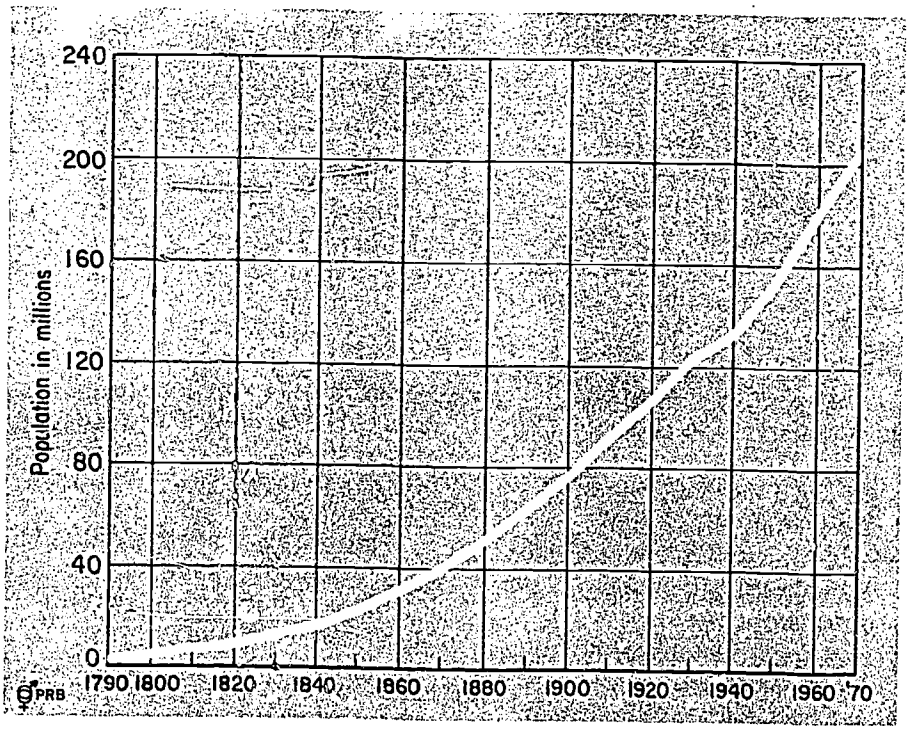
FIGURE 7

The Growth of U.S. Population, 1790-1970



Sources:

Developed by the Population Reference Bureau, Inc., from data in (1) U.S. Bureau of the Census. *Historical Statistics of the United States, Colonial Times to 1957.* Washington, D.C.: Government Printing Office, 1960. (2) U.S. Bureau of the Census. *Statistical Abstract of the United States: 1970.* Washington, D.C.: Government Printing Office, 1970. (3) U.S. Department of Commerce. "Final 1970 Census Figures." (News release) Washington, D.C.: Office of the Secretary, November 1970. Graph reproduced with permission from *Population Bulletin,* February 1971. p. 6.

Concept 3

The finite supply of natural resources—especially fossil fuels—is one limit to our ability to go on enlarging the carrying capacity of the world ecosystem.

Discussion

[I]t is evident that the fortunes of the world's human population, for better or for worse, are inextricably interrelated with the use that is made of energy resources. Although the human species has always used energy to meet its minimum biological requirements, it is only within recent centuries, with the advent of energy from fossil fuels and from wind and water power, that mankind has been able to increase its energy utilization per capita significantly above this minimum level. Despite the fact that the exploitation of these sources of energy has had a history extending over a period of several centuries, most of the developments during this entire period have occurred since 1900. (Hubbert 1969, p. 237)

In the United States, the population doubled between 1900 and 1956, but the amount of fossil fuel and related resources used increased fivefold. The U.S. demand for crude oil—a fossil fuel—tripled between 1925 and 1950. The world production of crude oil has risen an average of 6.9 percent each year since 1890. If world population growth continues at the present rate, the total amount of crude oil needed for all uses will double every 10 years. That amounts to a world population of 6 billion needing 123 billion barrels of crude oil per year by the year 2000.

What is the world's carrying capacity to accommodate this huge demand for crude oil? M. King Hubbert of the U.S. Geological Survey estimates that between 1,350 and 2,100 billion barrels of crude oil are left in the earth. If the population continues to grow in numbers and needs at current rates, and if fossil fuels continue to be used to supply the bulk of the world's energy requirements, "the time required to exhaust the middle 80 percent of the ultimate resources of the members of the petroleum family—crude oil, natural gas and natural-gas liquids, tar-sand oil, and shale oil—will probably be only about a century." (Hubbert 1969, p. 205)

Most people have heard about the finite supply of natural resources, particularly of fossil fuels, but they tend not to worry, because they assume that we can turn to atomic energy to meet our fuel requirements. Is this a valid assumption? The three basic mechanisms for getting energy from the atom and the limitations of each are as follows:

- *Burner or converter reactors,* which, like coal furnaces, burn a finite resource (uranium ores) and leave nothing to recycle for more energy output.

- *Breeder reactors,* which take U^{238} and convert it into energy and plutonium. Plutonium can be recycled for further energy output. However, breeder reactors are not yet being used, because they are not economical and cannot compete with coal combustion or burner reactors. The finite supply of uranium is being rapidly depleted by burner reactors.

- *Hydrogen fusion,* which traps energy directly from solar radiation, is not yet working, and physicists say it is so unstable as to be more dangerous than practical.

So we are trying to increase the carrying capacity of the whole ecosystem with little assurance that the cultural mechanisms so far devised to obtain energy subsidies can keep pace with the growing numbers of people and needs. Even if we did come up with a suitable technology, there is mounting scientific evidence that the accelerating rate of energy use by a world population expanding at the present rate could not continue indefinitely; eventually the tremendous amounts of heat and particles released would radically modify weather and other natural conditions of the world ecosystem.

Activities

1. Ask students to compare the population size and growth rate of the United States and other developed, developing, and underdeveloped countries. (Figures can be found in the current "World Population Data Sheet." See References.) Have them speculate on the future prosperity of the United States in light of its growth rate and import situation.

2. Invite a representative of the local public works or sanitary engineering department to report on the community's waste disposal system, recycling efforts, and future plans.

3. Ask the class to discuss corporate responsibility versus public and governmental responsibility for intensifying recycling efforts.

4. Have students write short papers on "Responsibilities of the Consumer." Suggest that they focus on life-styles—our demand for air conditioners, electric toothbrushes, etc. Allow class time for reading and discussing the papers.

5. Encourage students to investigate irresponsible consumption practices in the community and to determine how they can be corrected. If possible, help them initiate a program to improve consumption practices.

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Concept 4

Current population growth and resource depletion rates are putting pressure on the carrying capacity of the world ecosystem, as seen by the onset of automatic feedback controls.

Discussion

Modern nations have been distinguished by their large-scale use of technology to increase the carrying capacity of the world ecosystem. We have tended to assume that the population could continue to grow indefinitely, thanks to this ever enlarged carrying capacity. U.S. prosperity, based on an early abundance of natural resources and technological skills, has lulled most of us Americans into careless confidence in our own know-how. We cling blindly to superman technology and our "inexhaustible" natural resources as assurance of constant growth and prosperity for all. But it is becoming increasingly clear that our affluence rests on a shaky foundation.

We have failed to take advantage of one of the abilities that distinguishes human from animal populations: the ability to *choose* how we regulate—for ourselves—a high-quality, stable environment. Our unregulated growth in population and urbanization has led to a deteriorated, unstable environment. In the absence of voluntary growth controls we, like animal populations, are becoming subject to *automatic* feedback controls from the environment, to bring our accelerating growth rate back down to a stable level that is balanced with the finite supply of natural resources in the world ecosystem.

Here are some examples of how unregulated growth has made us vulnerable to the operation of automatic negative feedback controls:

- An unregulated concentration of people in urban areas has strained the carrying capacity of agricultural land. Within the past 50 years, the U.S. has changed from a farm-based to a city-based nation. A century ago the population was only 20 percent urbanized; today more than 70 percent of us live in metropolitan areas on 1.5 percent of the nation's land surface. If current trends continue, in 10 years 80 percent of all Americans will be living in urban or suburban settings. (See figure 8, page 70.)

  The land area occupied by urban and suburban population centers continues to expand. Urban sprawl annually paves over more than one million acres of agriculturally productive land. Each new American born takes an average of 0.2 acres of land out of cultivation in this manner. There are now 2.6 acres of agricultural land left in the U.S. to support each citizen. (Davis 1970, p. 14)

- The accumulation of unnecessary waste products associated with uncontrolled concentration and consumption patterns is straining the capacity of the environment to absorb them.

  According to the Heinows in their recent book *Moment in the Sun*, just one year's crop of American babies can be expected to use up 2½ billion pounds of beef, 200 million pounds of steel and 9.1 billion gallons of gasoline during their collective lifetime. . . .

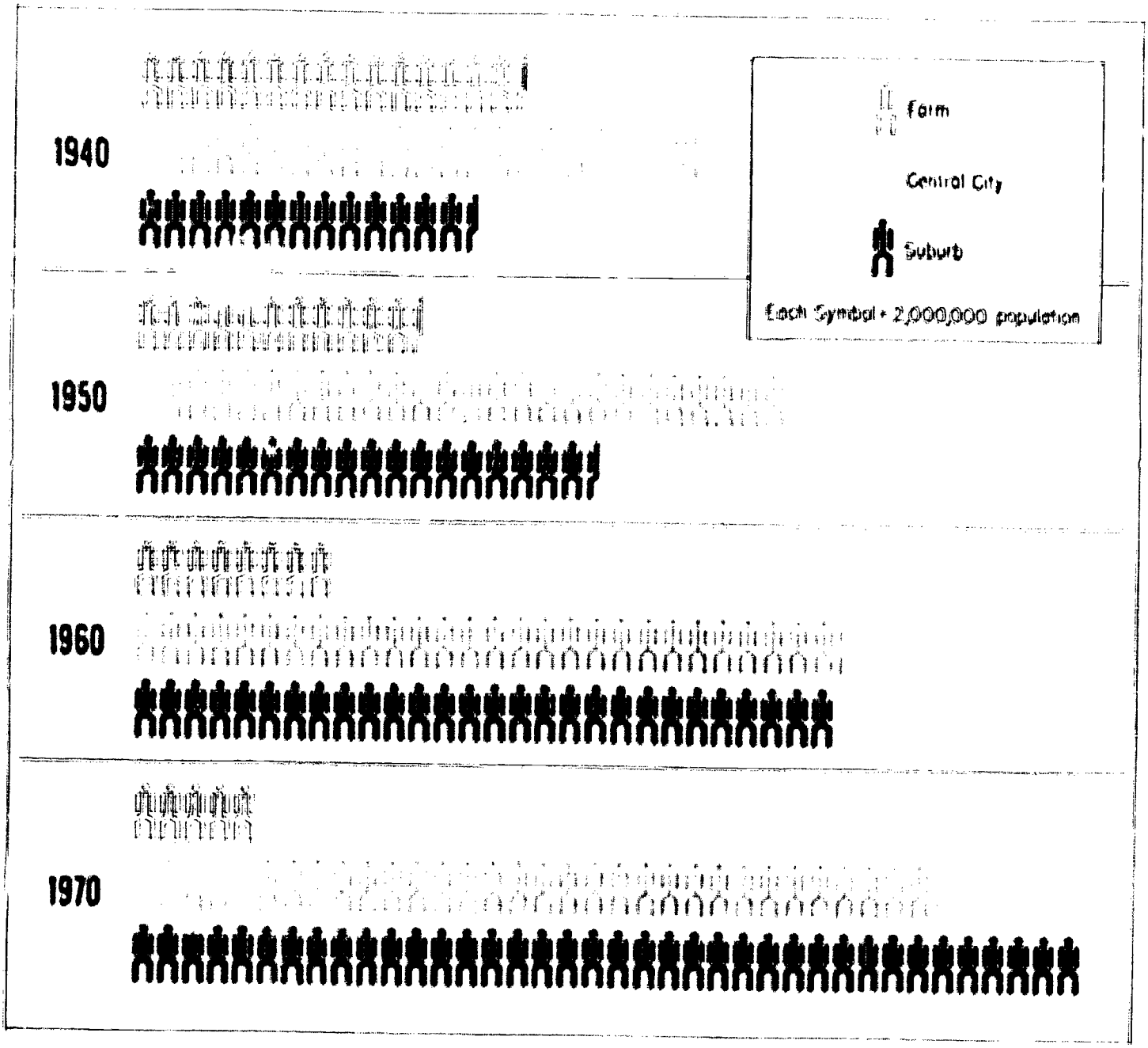
  [Each] will contribute his share to the 142 million tons of smoke and fumes, seven million junked cars, 20 million tons of paper, 48 billion cans, and 26 billion bottles the overburdened environment must absorb each year. (Davis 1970, pp. 14, 15)

- Misapplication of the economies of scale has made us more vulnerable to the consequences of an oversimplified environment. Much of our success in increasing the carrying capacity of the world ecosystem has been due to our efficient organization of labor, capital, and institutions for using natural resources. One element in this efficiency has been the application of what Adam Smith called "economies of scale," as in the assembly line method of production.

  Unfortunately, we have failed to realize that economies of scale, which apply to the artifacts of our life, do not apply to our limited natural resources. We converted from a feudal three-field system of land cultivation (which preserved soil fertility

FIGURE 8

Farm, City, and Suburban Population: 1940-1970



Sources:

through crop rotation) to monoculture planting techniques (row planting of one crop on a large tract of land). Monoculture, with the aid of mass-produced farm machinery, allowed more rapid planting and harvesting of crops. But in standardizing agriculture to increase productivity and accommodate the demands of a growing population, we oversimplified the landscape and so became vulnerable to nature's automatic feedback controls: absence of species diversity on large plots of cropland left them open to widespread pest damage, as in the Irish potato famines of the 1840's and the U.S. corn leaf blight of 1970.

- We have oversimplified the environment in other ways for the sake of increased efficiency in accommodating growing numbers of people and their needs. To cite three examples: (1) The large-scale reliance on electricity to satisfy power needs has made us more vulnerable to widespread power drains—brownouts and blackouts—during peak use periods. (2) Overdependence on one means of transportation, the internal combustion engine, has been a major cause of air pollution. The automobile contributes about 60 percent of the air pollution in the United States as a whole, and as much as 75 to 80 percent in some cities, notably Los Angeles. (Esposito 1970, p. 28) Automobile emissions have been linked to heart disease, respiratory ailments, and cancer. (3) Mass-produced, boxlike city apartments and suburban housing developments may be the fastest, most efficient way to keep up with growing housing needs, but they have made the landscape ugly and monotonous.

Activities

1. Share with the class the following statement by former Secretary of the Interior Stewart Udall:

> The attitude is more fatal today than the belief of some local leaders that economic salvation lies solely in getting new property on the tax rolls.

Find statements by local community leaders (as reported in newspapers or elsewhere) that reflect the common notion that since more people broaden the tax base, growth is therefore "good for the community." Ask students to discuss this notion in their own terms, using their own values.

2. Try the following activity only with the help of an economics teacher or professor. Preparatory reading should include "Impact of Population Growth," by Ehrlich and Holdren (see References).

Through computer-based analysis of statistics obtained from the California state comptroller's office, Dr. Kenneth Watt, a systems ecologist, studied cash flow into all the municipalities of California. He found that the tax cost per taxpayer is *higher* in growing and more densely populated communities. Analysis of the municipal budgets of such communities showed that the need for better sewage systems, more police and fire protection, more hospitals, more schools, and more community services of all kinds necessitated the higher tax rates. Watt concluded that the often intangible added costs of growth are not taken fully into account in cost/benefit analysis of proposed growth projects. If they were, the net benefits of population growth would be seen to be negligible or negative!

As an example, a realistic cost/benefit analysis of a factory project would include consideration of the following:

- *Costs*—More public services to provide for growth in population due to new jobs at factory; overcrowding of recreation areas; pollution control investment and surveillance needed at site of new factory.

- *Benefits*—More jobs for more people; population influx into community; wider tax base; more gross income for the community.

Have students debate the pros and cons of such a factory project in their own community and simulate public hearings on it. Make sure that all alternatives are considered. If the community were able to control growth, would that take the pressure off its valuable natural resources? What are the desirable characteristics of a stable community (one with zero population

growth) as opposed to a growing community? Is the gross income benefit of a growth project greater than the increased costs resulting from the project? Let students reach their own conclusions.

3. Have students analyze how the pressures of population growth in their community may be exceeding the carrying capacity of its education resources. Encourage them to try to obtain data from local or state planning offices on their community's rates of population growth and changes in age distribution over several decades. The change in ratio of education tax producers to education consumers should become obvious. Have the class discuss the problems posed and recommend ways to solve them.

4. The following activity is appropriate to the study of the history of any geographic region of the world. Have students make a list of major insect plagues, soil erosions, and other environmental catastrophes that have occurred as a result of misapplication of large-scale technology to natural resources since the agro-industrial revolution. For example, in American history the following might be listed:

- The number of immigrants to the United States doubled in the 1840's as a result of the Irish potato famine.

- The practice among early Southern plantation owners of mass-producing tobacco or cotton until the soil was exhausted, and then moving on, decreased the overall fertility of Southern soil and contributed to the downward spiral of the Southern economy that eventually led to the great northward migrations of impoverished farmers in the twentieth century.

- The result of the hydraulic mining was the massive movement of soil into the rivers that drained the Sierra Nevada. For every ounce of gold collected, tons of topsoil and gravel were washed into the river courses below. With the spring floods, clear streams became a chaos of debris, rocks, and silt, communities downstream were inundated with muck, and fertile bottomlands were blanketed with mud and gravel. The town of Marysville, along the Yuba River, was forced to build ever-larger levees that rose higher than the city's rooftops. In 1875, a big storm sent the Yuba over the levees and filled the city with silt. (Udall 1963, pp. 58-59)

- Many regions west of the 100th meridian should never have been plowed at all: the familiar pattern of farming in the East was out of place in a region of little rain. . . .

  The farmers' failure was a failure to grasp elementary earth facts. Like tobacco and cotton farmers of the South, they abused the land because they were ignorant of its laws of self-renewal. (Udall 1963, p. 61)

5. It is estimated that 40 to 60 percent of major urban land surfaces in the United States are devoted to motor vehicles. Have students secure from the local highway department or alderman's office a map showing major and minor roads in their own community. By using the map and doing some field work, they can estimate the portion of local land surface area devoted to motor vehicles. After measuring the total length on the map of each type of road passing through their community (residential streets, expressways, interstate highways, etc.), students should go out into the community in teams. One team might find out the average width of each type of road; other teams might determine the number and average surface area of gas stations, parking lots, garages, private driveways, etc. When each team has calculated the percentage of community surface area devoted to its "specialty," the teams can combine their results to determine the overall percentage of land area devoted to motor vehicles. How closely does the local figure match the national one?

6. U.S. land is being paved over at the rate of more than a million acres per year. Every new American born takes 0.2 acres of agricultural land out of cultivation. Let students find out for themselves whether the effects of this national trend are detectable in the local community. They can obtain population growth rate statistics and information on the community's housing and highway additions and other signs of urbanization from local government offices. Is there a correlation between accelerated growth and these indications of urban sprawl?

7. Between 1950 and 1970, the central city population of the U.S. declined from 34 to 32 percent of the total, while the suburban population rose from 24 to 37 percent. (Population Reference Bureau 1971, p. 8) Ask students to consider, How have urban sprawl and our neglect of voluntary controls of population growth left us more vulnerable to the operation of nature's automatic controls? What mechanisms of self-control can we now initiate to reverse our increased vulnerability to automatic feedback checks on growth?

On the local level, one example of our lack of concern for runaway growth and urban sprawl is the co-opting of farms by suburbs through constant modification of the tax and zoning laws. To avoid paying the new higher tax rates, a farmer on the outskirts of an expanding town must either move into town or buy another farm farther out. Either way, he is forced into a change of life-style or location that may be undesirable to him.

Farms are usually co-opted in piecemeal fashion, which aggravates the sprawl problem by encouraging the mushrooming of scattered, uncoordinated suburban developments. This uncoordinated pattern of settlement in turn makes transportation and other services more expensive and more difficult to provide. The population as a whole suffers too from the loss of productive agricultural land and open space for recreation.

Take students on a field trip to the edge of a town or city or community where this process of co-opting farmland is under way. Ask them to find evidence that new subdivisions were once farmland: remnant orchards in someone's backyard; an old barn serving as a garage; a hedgerow once serving as a windbreak between open fields now serving as a "wall" between housing developments. If a field trip cannot be arranged, take slides of such signs of urban encroachment to show in the classroom.

Have students find out precisely how changes in zoning and tax laws encourage growth and expansion and push the farmer farther out. Make arrangements for them to talk to a farmer who feels the pressure of urban encroachment. Would he rather move into town or buy a new farm farther away? Ask a real estate developer to present his side of the story. Because of the pressure of housing needs, he must acquire land and have it zoned and developed as quickly as possible. Ask the class to draw their own conclusions after hearing both sides.

8. As the total number and density of people in the U.S. goes up, their individual influence on political affairs goes down. In Abraham Lincoln's day a U.S. Congressman represented an average of 50,000 constituents. Today, with six times more people in the country, each Congressman represents an average of 500,000 constituents. As originally set up, the House of Representatives added an additional Congressman for a given additional number of people. But in 1912 it was decided that the House had reached its "carrying capacity" and that any more Congressmen would make it inefficient in running national affairs, so a limit of 435 members was established. Thus, as the population continues to grow, so will the number of constituents per representative; individual citizens will have less and less voice in political affairs.

Have students secure a series of maps from the Census Bureau showing change in boundaries and population size of their local congressional district through history. How has the process of "political emasculation" of the growing population taken place on the local level?

9. Urban sprawl has been accompanied by urban blight. In the rush to accommodate a growing population with adequate housing and public services, we have had to maximize our efficiency, with no time left for refining the quality of life.

- Ask students to list all the examples they can find in the nearest urban area of how urban blight is a negative feedback result of the large-scale dedication to efficiency in accommodating growth. For example, chain supermarkets, gas stations, drug stores, restaurants, etc., are efficient in providing for masses of people but create monotony

in the local landscape; look-alike interstate highways are efficient systems for moving masses of people around the country but prevent them from appreciating the local flavor of communities along the way; assembly-line, standard-design, ticky-tacky suburban housing units are efficient in providing dwellings rapidly for rising numbers of people, but at the cost of increasing visual monotony.

- Ask students to find out what types of sign ordinances and other controls exist in their community to discourage urban blight.
- Suggest that students with cameras photograph examples of local urban blight for display in the classroom. Incorporate into the display relevant jokes, magazine articles, and pictures collected by other students.

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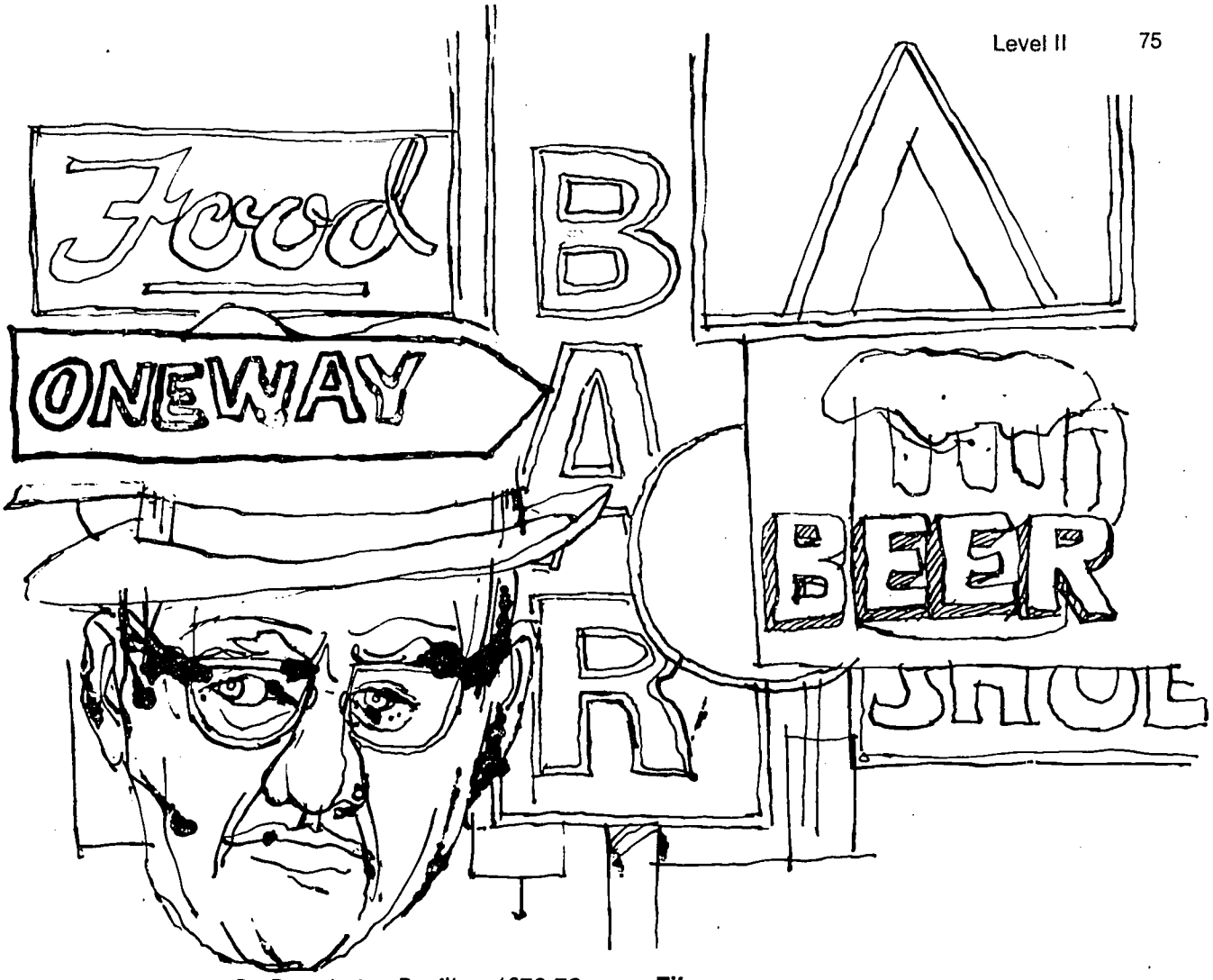

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Films

Boomsville. 11 min., 16mm, color. Learning Corporation of America, 711 Fifth Ave., New York, N.Y. 10022. 1969. *Short animated film produced by the National Film Board of Canada, depicting the historical sequences of modern civilization, particularly migration to North America. Little emphasis on population growth, but accurate portrayal of urban growth and related problems. No narration.*

The Changing City. 16 min., 16mm, b & w. Churchill Films, 662 N. Robertson Blvd., Los Angeles, Calif. 90069. 1963. *Presents the social, economic, and cultural opportunities of the city and traces urban growth through history to the present urban explosion. Urban problems—land use conflicts, blighted areas, population density, displacement and urban renewal—are presented as cases in need of sophisticated planning. Special emphasis on transportation.*

House of Man: Our Changing Environment. 17 min., 16mm, color. Encyclopaedia Britannica Educational Corporation, Rental Library, 1822 Pickwick Ave., Glenview, Ill. 60025. 1965. *Questions whether the problems of urban sprawl, pollution, and slums must be the perpetual legacy of the Industrial Age. Shows planning as the key to breaking this legacy. The film's strong points are its tracing of the history of world population growth and resource use and its presentation of a value orientation other than the economic one.*

Multiply and Subdue the Earth. 60 min., 16mm, color. Indiana University, Audio-Visual Center, Bloomington, Ind. 47401. 1967. *Emphasizes land as a precious resource and dictates ecologically sound land use. Economic gain as the basis for land-use planning is severely criticized. Case studies of New Jersey, Minnesota, Tahoe, Baltimore, and Hawaii convey the need for reform in taxing and zoning.*

The Time of Man. 50 min., 16mm, color. Holt, Rinehart and Winston, Media Sales, 383 Madison Ave., New York, N.Y. 10017. 1971. *Reviews human history from an anthropological perspective and looks at primates in their natural surroundings. Studies primitive populations in Africa and New Guinea to show how man can interact with his environment without causing severe imbalances. Main theme is our reliance on a supportive ecosystem. Concludes with 10-minute flashback on human intrusions into natural systems over the last 60 years. Stresses population stabilization as a necessary step in regaining balance.*

Urban Sprawl vs. Planned Growth. 22 min., 16mm, color. Stuart Finley, Inc., 3428 Mansfield Rd., Falls Church, Va. 22041. 1968. *Shows haphazard patterns of urban growth and cites planning done in Brandywine Creek, Pa. Major theme is need to understand the environment before changing it in any way.*

Science

Introduction

The material in this section could be appropriately used in several courses, including some outside the sciences. The following main ideas are developed at both levels of difficulty:

- Human beings need energy to survive individually as well as to develop socially and scientifically in a modern technological era.

- Our difficulty in finding adequate food and energy resources is due in part to population increase and in part to higher consumption rates in the industrialized societies.

- We are disturbing environmental balances through our attempts to exploit all possible food and energy sources to meet ever increasing demands.

Level I

Concept 1
Without a supply of energy, no living thing and no community of living things can survive.

Concept 2
Whether there will be enough food for the world population of the future depends upon what is done now about both food production and population growth.

Concept 3
In our search for food, we are altering our environment at an accelerating pace.

Level II

Concept 1
Without a supply of energy, no living thing and no community of living things can function.

Concept 2
Resource requirements depend, among other things, on the size and distribution of populations.

Level I

Concept 1

Without a supply of energy, no living thing and no community of living things can survive.

Discussion

We human beings often feel we have very little in common with other animals or other living things. Actually, however, all living organisms are subject to the same fundamental biotic laws. These laws govern both individuals and groups (populations). Individuals are well defined units; they consume food, respond to the environment, grow, and reproduce. A population is much more difficult to study, because it cannot be isolated from the environment and because it is always changing. And a human population—the people who live in a given area at a given time—is the most complex of all, because of the human ability to influence the environment.

The human *ecosystem* is the system in which groups of individuals (populations) interact with the environment through culture (technology and social organization). It is our cultural mechanisms that enable us to influence our environment to the point of seeming immunity to the biotic laws.

The course of events within an ecosystem depends upon many factors, the most significant of which is energy. No system—human or otherwise—can work without it. For all living things on earth, the prime source of energy is the sun. Note that the flow of energy from the sun through a biological community is not a cycle but a one-way flow. Nutritive material (energy) being transferred through a food chain or web from one link to another

> . . . becomes less and less available to organisms as it goes through the system. This means that the energy in the system must continually be renewed from our only significant source, the sun. In terms of population relationships, then, the size of the producer populations—populations of organisms capable of converting solar energy into a form that can be consumed by other organisms—will determine the size of all consumer populations. (Cairns 1966, p. 60)

Human beings are consumers; the size of human populations is, therefore, dependent upon the availability of energy they can use.

Activities

1. Ask students to list and discuss the cultural (scientific, technological, social) mechanisms human beings have created in order to sustain more and more people within an ecosystem—such mechanisms as gunpowder, DDT, and the plow. In what ways did each breakthrough expand the resource base on which the population depended for food?

2. Invite a biologist and a representative from your state or local planning department (or a professor of demography from a nearby university) to visit your class and compare definitions of the word *population*. Alert students in advance to the possible differences—e.g., the demographer studies numbers of people in a culturally defined and specified area (census tract, metropolis, state, country, world), while the biologist might focus on animal groups in a naturally bounded area (forest, swamp, plain). Encourage students to inquire about methods and focuses common to both demography and biology.

3. Have a team of students (a) study one of the many energy-food chains (see pages 46 and 79 for examples), and then (b) use visual aids to share their knowledge with the class.

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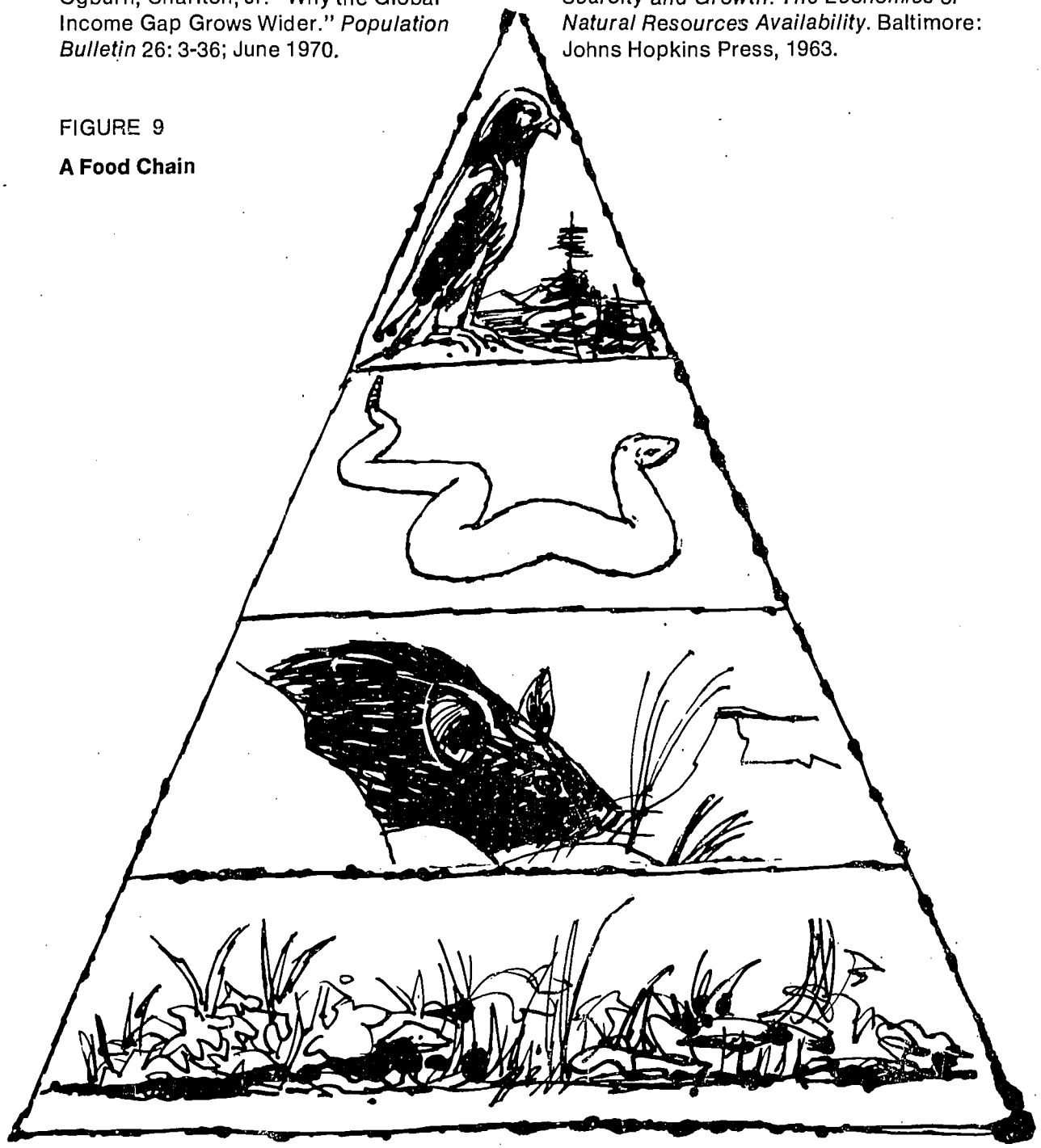
FIGURE 9

A Food Chain



Source:
Based on a drawing in Bielfeld, Maurice. *Biology*. Woodbury, N.Y.: Barron's Educational Series, Inc., 1969. p. 165.

Concept 2

Whether there will be enough food for the world population of the future depends upon what is done now about both food production and population growth.

Discussion

Each of us was born once and will die once, but a population has a birth rate and a death rate that change over time, depending usually upon environmental circumstances. If the two rates are equal, the result is a stable population, as long as no people move in or out. However, if the birth rate is higher than the death rate, the population will grow. This is the situation in most large American communities and in most of the world's countries.

The word *population* is often used to mean only the *number* of people living in a given area. But it is important to be aware of two other measures of population: population growth rate and population density. The *growth rate* is now a crucial measure because of its rapid acceleration over the last 300 years. Until modern times, the growth rate of world population resulted in a doubling time (the length of time it takes a population to double) of many hundreds of years. Now, however, the world's population growth rate (2 percent per year) doubles the population size every 35 years. (See pages 15-16.)

Population *density* is important to the biologist and the ecologist because of their concern with interactions between individuals and the environment. Throughout history there have always been isolated areas of high population density, but today much of the globe is rapidly being populated to the point of congestion.

Given a limited amount of land, increasing population growth rates result in increasing population density. This growth pattern has serious consequences for our efforts to provide an adequate food supply for the world's present and future population. The main resources needed to produce food are water, mineral fertilizers, and *arable land*. While science can invent new sources of energy, it cannot create new space.

"The major fact about man and land is that the best land resources are now occupied, and all resources are known to some degree." (Hendricks 1969, p. 82) About one-fourth of the world's 32 billion acres are best suited for cultivated crops, and about another one-fourth for grazing. About one-half of the arable land (3.5 billion acres) is already being used, and more than half of the grazing land.

It is often argued that if present world food production could be evenly rationed, there would be enough food to satisfy both calorie and protein requirements for everyone. But such a redistribution would demand drastic reductions in the consumption rates of the now affluent populations (e.g., the United States). The likelihood of such sacrifice and social reform being undertaken seems remote.

What are the alternatives? One frequently mentioned is increasing the food yield from the sea. But according to William Ricker's analysis (1969), it is improbable that food from the sea could be increased to much more than about 2½ times the present annual yield of 60 million metric tons of fish (containing only 12 million metric tons of usable protein). An increase to as much as four times the present yield seems highly unlikely. Bear in mind also that while aquatic food is a very good supplemental source of protein, it is a very poor source of calories. If the estimated maximum production of food from the sea could be achieved by the year 2000, it would supply about 30 percent of the *minimal* protein requirement of the people expected to be living then, but barely over 3 percent of the calorie requirement. (Ricker 1969, p. 87)

Only the land can provide an adequate supply of food to meet our anticipated calorie needs, and then only through

> . . . maximum increases in productivity of existing lands, cultivation of all potentially arable lands, new crops, the use of more vegetable and less animal protein, continued risky use of ever-new but hopefully degradable biocides, chemical or microbiological synthesis of foods, and other innovations. (Committee on Resources and Man 1969, p. 5)

According to Sterling B. Hendricks, food production is not likely to be increased beyond about nine times the present level. This figure would seem to limit the earth's ultimate carrying capacity to 30 billion people, "at a level of chronic near-starvation for the great majority!" (Committee on Resources and Man 1969, p. 5) Keep in mind that a world population of 30 billion is only slightly more than three doublings of the present population (3.8 billion), and that the doubling time now is only about 35 years.

Activities

1. Ask the class to investigate all possible environmental circumstances that might determine (a) individual family size and (b) a society's birth rate, death rate, and immigration rate. (See Appendix A.) Encourage students to interview their own parents, family friends, and neighbors, to observe animal populations, and to speak from personal and family experience in order to uncover all possible economic, health, natural, psychological, political, and social circumstances that can cause changes in vital rates. Arrange a class debate on which of these forces most influence the behavior of human populations.

2. Have students decide the best way to communicate to the rest of the school the rapid rise in human population growth rates over the last 300 years—e.g., a huge wall graph for a school corridor, a short

TABLE 6

Percentage of Potentially Arable Land Now Cultivated and Acres Cultivated per Person

Continent	*Percent cultivated*	*Acres cultivated per person*
Asia	83	0.7
Europe	88	0.9
South America	11[a]	1.0
Africa	22[b]	1.3
North America	51	2.3
U.S.S.R. (Europe-Asia)	64	2.4
Australia	2[c]	2.9

[a] Tropical limitation
[b] Desert and tropical limitation
[c] Desert limitation

Source:
Hendricks, Sterling B. "Food from the Land." *Resources and Man.* (Compiled by Committee on Resources and Man, National Academy of Sciences–National Research Council.) San Francisco: W. H. Freeman and Company, 1969. p. 68 (table 4.3).

slide show with narration, etc. They will need the following information:

World Population Growth
(by "Doubling Time")

Year	*Population*
1 A.D.	250,000,000
1700	500,000,000
1850	1,000,000,000
1930	2,000,000,000
1970	3,500,000,000

3. Assign students to find out in which countries of the world a large proportion of the people are not getting enough food (calories? proteins?). Are they always countries that we consider "poor" or "underdeveloped"? Are they always countries that have very rapid population growth rates? What about the United States? Do we have hungry and malnourished families? What factors besides numbers of people to feed, amounts of land used for food production, and agricultural technology available determine whether a society can provide enough food for its members? Table 6 (page 81) may help answer some of these questions.

4. Have each student do a case study on the land area where he or she was born (or, in difficult cases, on the neighborhood in which the school now stands), to learn what kinds of pressures were put on people to change the way their land was being used. Changes might include—

- Forest land cleared for cultivation.
- Forest land cleared for housing development.
- Forest land flooded for dam backup.
- Grazing land used for recreation (ski area).
- Grazing land used for cultivation.
- Desert area irrigated for cultivation.
- Arable land covered with industrial plants.
- Arable land cemented over for highway development.

Ask each student to trace his or her area's land use history as far back as possible.

5. Forests and grasslands are both subject to encroachment for increased food production. Have students invite a nutritionist, an agronomist, and a geographer to visit the class and to explain the value of maintaining these types of land as they are. Be sure to review the food chain components beforehand. The students should know about herbivores (cellulose utilizers)—e.g., deer—which are able to use plants otherwise wasted to us and can then supply us with necessary protein.

6. Schedule a period around the following questions: What is protein? What is a calorie? Why does the body need a minimum daily supply of both calories and proteins? What are the different sources of each? Where are they located in the food chain? Looking to future sources of these two food requirements, what about food grown in the ocean? Why is it that aquatic food is a good source of protein, but not of energy food or calories?

7. Ask students to define and explore the concept of the "carrying capacity" of ecosystems. Is it a scientific concept? Is it a cultural concept? How do we measure "ultimate" carrying capacity? What signs of breakdown should we look for? Is food shortage one of them? Can a system as large as the earth have an ultimate carrying capacity? Have we reached it? On what values or scientific criteria do you base your answer?

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Concept 3

In our search for food, we are altering our environment at an accelerating pace.

Discussion

The new seeds and new approaches to irrigation developed in the late 1960's offer hope for nations whose populations are growing rapidly and putting great pressure on the food supply. While these agricultural breakthroughs have not yet reached all poor nations, and while they are limited so far to cereals (principally wheat and rice), they have already altered the worsening food shortage in some of the most populous nations of Asia—India, Pakistan, Indonesia, Turkey, and the Philippines. The new seeds and "yield takeoff," as major forces of this "green revolution," are reducing the costs of agricultural development and hence the costs of meeting food needs.

But there are formidable forces tending to frustrate any real gains in the long run. In the poor countries particularly, attempts to produce more food are destroying the environment. Lester Brown, an agricultural economist with the Overseas Development Council, was among the first to face squarely the implications of the new agricultural technology. The following treatment of the ecology of population growth is based heavily on his *Seeds of Change: The Green Revolution and Development in the 1970's.*

As a poor country's population grows, an ever expanding area of land is cleared for cultivation. As more people demand more fuel for heat and cooking, forests are cut far beyond the point of natural replenishment. Then people must rely on cow dung for their fuel supply. This in turn means that livestock populations tend to increase along with the human population, stripping the land of grass cover. The forage needs for cattle already exceed replenishment levels in many poor countries.

As population pressure continues to build, not only is more land cultivated, but the land remaining is less suited for cultivation. Once valleys are filled, farmers begin to use the hillsides, causing serious soil erosion. As the natural cover that slows runoff is reduced, soil structure deteriorates, and floods become more frequent and severe.

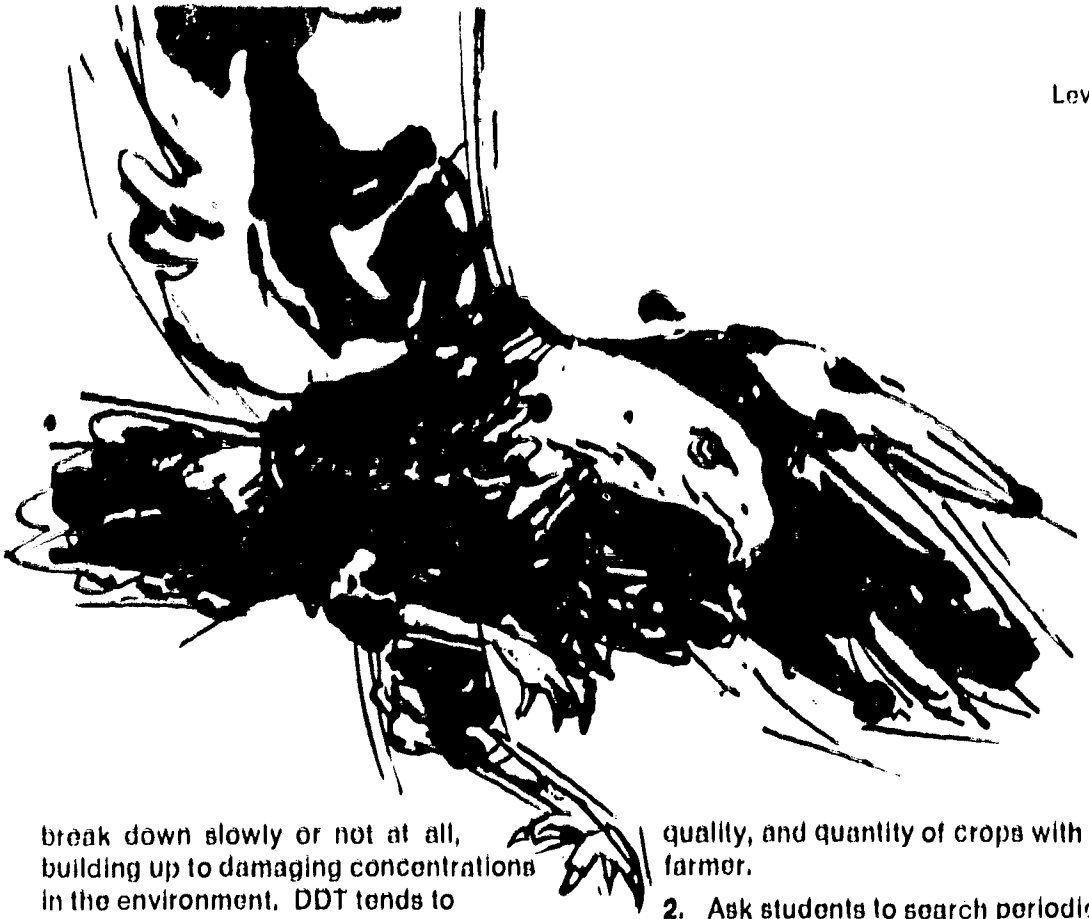
In much of the developing countryside the relationship between man and the land has become very unstable. In India, Pakistan, and parts of the Middle East, North Africa, and Central America, millions of acres of cropland have deteriorated to the point of abandonment. Often the displaced farmers and their families move to the cities, swelling the urban slums.

Not only is the soil destroyed by erosion, but eventually the irrigation systems as well. An example can be seen in the island of Java, where the overcutting of forests has resulted in the silting of irrigation canals, reducing their capacity. Each year the damage from floods, droughts, and erosion becomes more severe.

When we press nature too hard, the results can be disastrous. The "dustbowl" years of the 1930's offer an example very close to home. The situation restabilized only after 20 million acres of cropland were reserved for fallow each year and thousands of miles of windbreaks were planted. The United States was lucky to have the resources necessary to correct its mistakes—particularly the ability to withdraw large areas of land from cultivation each year. This option is not always available to poorer countries.

The pressure of population causes farmers not only to move onto marginal land but also to step up agricultural production with the help of fertilizers and pesticides. The danger in making heavy use of fertilizers is that their nitrates will accumulate in bodies of water, stimulating the excessive growth of certain kinds of plant life, upsetting the ecological balance and so destroying many species of fish.

DDT, dieldrin, and other 2-chlorinated hydrocarbon pesticides are toxic and



break down slowly or not at all, building up to damaging concentrations in the environment. DDT tends to concentrate in the predatory animals, including man. It damages the reproductive capacities of certain birds, such as eagles and hawks, and some types of fish. Its precise effect on human beings at current levels of concentration is not yet known but is being carefully investigated by biologists and medical experts.

We see then that, in our desperate attempts to feed our ever growing numbers, we have relied on technological methods that often have extreme and delayed consequences on ecological balance. Our desire to conquer nature often means that we lessen the probability of inconveniences at the cost of increasing the probability of disasters.

Activities

1. Have students find out for what crops the use of DDT or dieldrin is necessary. If possible, let them invite a farmer who raises these crops to visit the class and explain why he must use such insecticides to produce successful yields. Students can document for themselves the benefits of insecticides by bringing examples of fruits and vegetables—some sprayed, some not—for comparison. Discuss size, quality, and quantity of crops with the farmer.

2. Ask students to search periodicals for reports of DDT buildup in animal populations. When several cases have been found, lecture, or ask a biochemistry student or professor to lecture, on the makeup of insecticides and on how concentration builds up through the food chain. Discuss the implications for human beings.

3. In some situations, even with modern irrigation systems and the application of increased scientific know-how to food production, we still cannot keep up with growing populations. Suggest a group research project on Egypt's Aswan Dam. Encourage students to find out as many details as possible about the task of supplying water to this desert area and about the dam's many repercussions. Different students might want to cover ecological consequences, health problems, costs, timing, increases in crop yields anticipated and obtained, population growth since the planning stages, increase in food supply per capita, etc. When the research is completed, plan a presentation of the results to another class. Focus the presentation around the question, Can science and technology solve the world's food problem?

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Films

The Mounting Millions. 60 min., 16mm, b & w. Indiana University, Audio-Visual Center, Bloomington, Ind. 47401. 1969. *Focuses on the need for economic and agricultural development and social change in India. Special emphasis on alternative solutions to the severe problem of food production shortages.*

Population Ecology. 19 min., 16mm, color. Encyclopaedia Britannica Educational Corporation, Rental Library, 1822 Pickwick Ave., Glenview, Ill. 60025. 1964. *Gives facts of population growth in a variety of organisms. Includes lab demonstrations of different animal responses to the same environmental limits. Portrays fluctuation and limitation of population sizes as the environment changes, and explains population growth curve through the history of mankind. Concludes that we too must be governed by natural laws and indicates alternative ways of limiting population: starvation, disease, war, birth control planning.*

Tomorrow's Children. 17 min., 16mm, color. Perennial Education, 1825 Willow Rd., Northfield, Ill. 60093. 1971. *A strong indictment of man's refusal to follow nature's laws of balance. Shows our potential to respond to the physical and psychological needs of our future children through control of our consumption and reproduction patterns.*

Tomorrow's World: Feeding the Billions. 54 min., 16mm, color. McGraw-Hill, Film Preview Library, Princeton Rd., Highstown, N.J. 08520. 1968. *Opens with a clear portrayal of the history of population growth and the grave implications of present trends. Focuses at length on various methods being devised to farm the tropics, deserts, and oceans.*

Level II

Concept 1

Without a supply of energy, no living thing and no community of living things can function.

Discussion

All life as we know it depends on the transformation of radiant energy from the sun into chemical energy. Human beings, highly dependent upon energy for their existence, must compete with other members of the ecological system for a share of this energy. Much of the following discussion of energy use and supply is taken from Hubbert (1969).

At the earliest stage of human development, our ancestors' capacity to utilize energy must have been limited to using the food they ate--then as now, about 2,000 kilocalories per man per day. But the human species has slowly learned to utilize energy from animals, the smelting of metals, the burning of wood and coal, and the harnessing of wind and water. Increasing the usable energy supply of our biologic and inorganic environment has resulted in a continuous increase in human population. Until the last few centuries, however, the rate of total energy consumption remained much lower than the rate of population growth. Consequently, the population tended to remain in balance with the increase in energy supply, while the biologic and inorganic energy consumed per capita remained at a low, nearly constant level.

When fossil fuels came into use, that pattern changed. Now the energy supply could be used faster than the human population could grow. The world consumption of coal and petroleum has increased by about 4 percent per year for the last hundred years. The world population now grows by 2 percent per year. This means that at present the world's average nonnutrient energy consumption per capita is increasing by about 2 percent per year.

The earth's deposits of fossil fuels are finite in amount. They can be renewed only in time periods of millions of years. The Committee on Resources and Man estimated in 1969 that the earth's coal supplies could provide a major source of industrial energy for another 200 to 300 years, while the petroleum supplies—smaller originally and consumed more rapidly—would last only about 70 to 80 more years. Since 60 percent of the world's present production of energy for industrial purposes is obtained from petroleum and natural gas, the imminent depletion of these fuels is a serious problem.

Most of our consumption of fossil fuel energy has occurred in an extremely short period of time. For example, even though coal has been mined for about 800 years, half of the total mined during that period has been extracted over the last 34 years. Half of the world's cumulative production of oil has occurred during the last 15 years. Obviously, the rates of formation of fossil fuel deposits are negligible as compared with their rates of consumption.

> Consequently, during the period of human exploitation, the resources of the fossil fuels may be considered to consist of fixed initial supplies which are continually diminished by human consumption. The quantity remaining in the ground at any given time must be equal to the difference between this initial supply and the cumulative production up to that time. Therefore, the complete history of the production of a fossil fuel must display the following characteristic. The curve of the rate of production, plotted against time on an arithmetic scale, must begin at zero, rise until it passes over one or more maxima, and finally decline gradually to zero. (Hubbert 1969, p. 167)

It appears, then, that after another century or two, our dependence on sources of energy other than the fossil fuels will be unavoidable. What are the alternatives?

- *Solar radiation* is the most obvious potential large energy source. The thermal

solar power at the mean distance of the earth from the sun amounts to 0.139 watts per square centimeter; the thermal power intercepted by the earth as a whole is 17.7×10^{16} watts—about a hundred thousand times larger than the world's presently installed electric power capacity. So solar energy is certainly of adequate magnitude. It will also be in constant supply for millions of years. (Remember that solar radiation is also the energy source for the entire biological system, through the process of photosynthesis.)

An area of only 42 square kilometers would need to be covered with solar energy–collecting devices in order to collect as much potential electric power as is now supplied by water power and fossil fuels. But the complexity of transmitting, storing, and finally transforming the solar energy into conventional electric power and the costs of the metals and physical, chemical, and electrical equipment required make the whole process impractical compared to present thermal and hydroelectric processes.

• The total potential *water power* capacity of the world is still about four times as large as the total installed electric power capacity. If the water power capacity were fully developed, therefore, it would seem that it would be adequate for the world's present rate of energy consumption and that the world could continue at its present industrial level on water power alone.

But other considerations cast doubt on this assumption. Would people be willing to sacrifice some of their most beautiful scenery in order to develop the full capacity of water power? Also, streams that are dammed for reservoirs continuously deposit loads of sediment; over a century or two, most man-made reservoirs are due to become completely sediment-filled. So most water power sites may have periods of maximum usefulness of only one or two centuries. It seems questionable, then, whether the world can rely on water power as a substitute for the depleted fossil fuels.

• Another source of energy is *tidal power*. It is derived from the combined kinetic and potential energy of the earth-moon-sun system. The actual tidal-electric power is obtained from the oscillatory flow of water as it fills and empties partially enclosed coastal basins during the rise and fall of the tides. By enclosing these basins with dams to make a water level difference between the basins and the ocean, the overflow from the dams can drive hydraulic turbines, which in turn propel electric generators.

There are some real advantages to the use of tidal power: it is capable of being developed in large units in certain localities, produces no offensive wastes, and consumes no exhaustible energy resources. But the world's potential tidal power, fully developed, would amount to only one percent of its potential water power, and to an even smaller percentage of its total power needs.

• *Geothermal energy* is heat conducted from the earth's interior. The world's geothermal energy resources could sustain a withdrawal rate of 10 to 100 times that of the present for only the next 50 years. Like tidal power, geothermal power is only available in certain localities.

• This leaves us with *nuclear energy* as the only remaining energy source of the necessary magnitude. Although the earth's resources of uranium, thorium, and deuterium are finite and therefore exhaustible, the magnitude of these resources in terms of potential energy content is very large. Using breeder and fusion reactors, the power requirements of an industrialized world society could be supplied for some millenia. But there are problems with nuclear energy, too (see page 67).

It is not yet known whether further industrial development in the next century will be slowed by limited mineral resource supplies. The biggest unknown factors are population and rates of consumption. If population and demand level off at some reasonable plateau and if resources are used wisely, industrial society can continue for centuries. But technological and economic brilliance cannot create natural resources. It seems obvious that the exponential increases in demand that have long been the pattern cannot be met indefinitely.

Activities

1. Schedule a period around energy: its various kinds (solar, chemical, electrical, kinetic, etc.), how it is transformed from one kind to the next, how animals use energy, and particularly how man uses it. Trace the increased number of ways man has made use of various energy supplies. Encourage students to link these steps with changes in social organization and means of production.

2. Through class discussion distinguish between nutrient and nonnutrient energy consumption. Challenge students to trace the point in human history when per capita consumption of nonnutrient energy increased dramatically. What scientific advances made this increase possible?

3. Students should become well acquainted with fossil fuels, their compound makeup, and the geological process of formation (timing and conditions).

- Have students identify the various uses of fossil fuels in their own homes and everyday lives.
- Take a short group trip through an industrial area and encourage students to note probable uses of fossil fuels.

4. Ask three small groups of students to present in graphic form a picture of fossil fuel use and world population growth over the last 1,000 years. One group can focus on coal consumption, one on oil consumption, and one on population growth. Ask that the groups use graphs of the same type and size, for ease in making comparisons. Ask for a discussion leader to point out relationships between the growth curves.

5. Assign term papers on sources of energy as future alternatives to fossil fuels, letting each student write on one energy source (solar radiation, water power, tidal power, geothermal energy, or nuclear energy). The papers should include information and ideas on economic feasibility, magnitude potential, exhaustibility of source, aesthetic considerations, and ecological consequences. The Hubbert and Ogburn articles (see References) will be especially helpful.

This is a difficult and time-consuming assignment. Encourage cooperation among students who have chosen the same alternative.

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Concept 2

Resource requirements depend, among other things, on the size and distribution of populations.

Discussion

The study of human populations began in ancient times. Censuses were taken regularly by the ancient Chinese and Romans, primarily for tax purposes. The beginning of population study in modern science, however, came with Thomas Robert Malthus' *Essay on the Principle of Populations As It Affects the Future Improvement of Mankind* (1798).

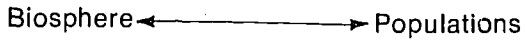
Malthus argued from the evidence then available that all kinds of organisms, including man, tend to multiply up to a limit. What limits the number of organisms in a given species? Malthus, in his famous "dismal theorem," offered three propositions:

- Population is necessarily limited by the means of subsistence.
- Population invariably increases where the means of subsistence increase, unless prevented by some very powerful and obvious checks.
- These checks, which keep population on a level with the means of subsistence, are all resolvable into moral restraint, vice, and misery.

Since resources are limited, as population increases, the supply of resources per person must eventually fall to an unacceptable level. This is the crux of the Malthusian dilemma.

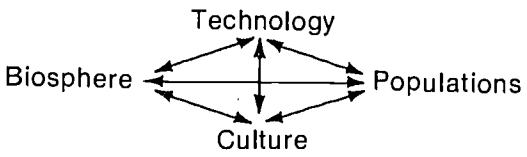
As their unit of study ecologists use the ecosystem rather than only the biological community. Thus they consider both the living organisms and their physical environment, which together form an interacting system:

Ecosystem



The interaction between organisms and environment is particularly noticeable in the case of human beings. Our actions are influenced in many ways by the nature of the physical setting we live in—desert, coast, mountain, forest; but we also have the ability to alter our environment through the social mechanisms of technology and culture. A diagram of the human ecosystem would look something like this:

Human Ecosystem



A prime conclusion of ecology is that species whose populations exceed or approach too closely the carrying capacity of the resources in the space occupied undergo reduction. But human beings have succeeded in increasing both the space they occupy and its carrying capacity, and we will continue to do so. Therefore, our relationship to our physical environment is no longer one of direct dependence for sustenance. We have created our own environment, many parts of which require high levels of density for their operation (e.g., large industry).

However, we cannot expand the earth's living space and carrying capacity indefinitely. Increasing populations place increasing demands on finite resources of all kinds: food, water, minerals, space. At present growth rates, by the year 2000 new urban facilities equivalent in capacity to those already existing will be required in the developed world, and correspondingly more in the underdeveloped world. This prospect calls for a totally different view of our cities and their resource requirements. Both population limitation and better resource management seem clearly mandatory and must be effected immediately.

Knowledge of animal populations suggests that environmental factors other than simple limitation of material resources may act in unexpected ways to limit populations before theoretical maxima are reached. It is probably purely hypothetical to consider whether the earth could carry three more doublings of the human population. One of the most crucial unanswered questions is whether, in spite of the flexibility we gain through technology and organization, there are definite limits inherent in our biological/genetic nature. Just how far can adaptation take us? Have we already gone beyond the limits but not yet recognized the results?

Activities

1. Challenge students to debate the validity of the three Malthusian propositions. Be sure first that they understand how a human ecosystem differs from other ecosystems. They must understand the added forces of technology and social and economic organization before they can handle the applicability of Malthusian theory to our present-day situation.

Ask the debaters to discuss both modern and traditional economics. How do political and trade agreements affect relationships between population and resource supply? With our present transportation and communication systems, what are the most realistic boundaries on the human ecosystem? Does the "spaceship earth" concept make the predictions of Malthus more or less valid?

2. Ask each student to select one natural resource (copper, water, natural gas, wood), to classify it as renewable or nonrenewable, and to justify this classification to the rest of the class by explaining what geological or biological process formed the resource. Encourage students to research and report on (a) consumption levels of their resources, by country, and (b) estimated remaining supplies. The first two sources listed in the References that follow offer useful information for this activity.

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House of Man: Our Changing Environment. 17 min., 16mm, color. Encyclopaedia Britannica Educational Corporaton, Rental Library, 1822 Pickwick Ave., Glenview, Ill. 60025. *Contrasts the natural ecosystem of a pond with man's environment, the city. Questions whether the problems of urban sprawl, pollution, and slums must be the perpetual legacy of the Industrial Age. Shows planning as the key to breaking this legacy. The film's strong points are its tracing of the history of world population growth and resource use and its presentation of a value orientation other than the economic one.*

To Each a Rightful Share. 30 min., 16mm, b & w. McGraw-Hill Film Preview Library, Princeton Rd., Highstown, N.J. 08520. 1961. *Contrasts the "have" and "have-not" nations in the battle for strategic resources. Shows Western man's wasteful use of these resources.*

Sociology

Level II

Introduction

It is likely that population variables are at least mentioned in most high school sociology courses, since demography presently exists as a formal discipline within sociology. It is also likely that family size is discussed in a "marriage and family" section of the course. It seems unlikely, however, that family size is studied as an effect of the social environment and as a determinant of the physical environment (through its role in population growth). The concepts developed in this section, therefore, will focus on the overall relationship of family, community, and population size to the carrying capacity of the human ecosystem. The discussions will attempt to answer the following sociologically relevant questions:

- Is the family size decision a behavior determined by social norms and therefore subject to alteration by planned social change?
- How direct is the relationship between population variables and certain environmental and social problems?
- What changes in social organization result from this relationship?
- How is a balanced ecological system dependent upon innovation or change in the social system?

Concept 1

The social environment is a significant determinant of family size, and family size norms change over time.

Concept 2

The quantity of natural resources used by a society is determined less by population size than by consumption patterns, economic system, and degree of urbanization and industrialization.

Concept 3

With growing numbers and concentrations of people, our social lives become increasingly complex. Urban living brings a wider range and greater frequency of interpersonal contact and, in addition, more intensive competition for resources—both physical (e.g., space, raw materials, air, water) and social (e.g., health, education).

Concept 4

Because certain resources are finite, all human elements dependent upon them for survival within the ecological system must adjust to their limitations.

Level II

Concept 1

The social environment is a significant determinant of family size, and family size norms change over time.

Discussion

Childbearing decisions are strongly affected by common social influences—school, family, church, community. The concept of "norms" is at the base of what is meant by social determination of family size. Norms act as blueprints for the kind of behavior that is appropriate at a given time. They define such things as the socially acceptable number of children for the members of a specific culture or group.

Studies of family size in the United States reveal a clear majority of families in one category: two or three children. Two or three is the "central tendency" in number of children. The scattering of numbers around this category indicates the "range" of acceptable family sizes. Other demographic behavior (age at marriage, age of mother at birth of first child) shows a similar pattern of distribution.

The central tendencies and the norms operating behind them differ from society to society and from group to group, and they also change over time. Contrast, for example, the average number of children to which women in the United States and Mexico had given birth by age 40-49 (1960 figures):

United States	*Mexico*
2.5 children	4.9 children

At the extreme end of the fertility continuum are the Hutterites, a religious sect in the U.S. whose average completed family size is 10.4!

Note also the change in the perceived "ideal" American family size over the last 30 years:

1941—2 children
1959—4 children
1970—3 children.

Activity

1. Have students take a fertility census of their own families and friends. This should provide a representative sample from which to begin the study of family size and society's influence on it. Questions to ask:

- How many children have been born alive to your mother (including yourself and any children who may have died)?
- What do you think is the ideal number of children for a family to have?
- Do you expect to have children yourself? If so, how many?

Tabulate the survey information. Through a statistical analysis determine the range and central tendency of family size for the students' present and future families.

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Concept 2

The quantity of natural resources used by a society is determined less by population size than by consumption patterns, economic system, and degree of urbanization and industrialization.

Discussion

Every social unit (family, community, society) is, in part, organized to provide adequate resources for all its members. Of course, the greater the number of people in the unit, the more resources that unit will require. When an increase in population is accompanied by a rise in material expectations, still more natural resources must be obtained by the unit to provide for its members.

U.S. citizens make up only 6 percent of the world's population but use between 30 and 50 percent of the nonrenewable resources consumed each year. Wayne Davis explains that 203 million Americans can have a far more serious impact on the land than 540 million citizens of India can, because of "our affluence and our technological monstrosities." Davis' term *Indian equivalents* simply means the number of average Indian citizens necessary to produce the same detrimental effect as the average American produces on the land's ability to support human life. If this ratio is 25 to 1 (which Davis feels is an extremely conservative estimate), then 1,000 citizens added to an American community would have the same effect on its land resources and would consume as much natural material as 25,000 people added to an Indian village would. (Davis 1970, pp. 13-14)

It is the highly urbanized, technologically advanced societies that create the disproportionate per capita demands for raw materials. And as yet these demands show no sign of decreasing. Per capita consumption of energy in the United States increased 13.4 percent just between 1960 and 1965. In the short run, of course, this kind of growth does not impoverish us; it enriches us economically in the sense of providing each of us on the average with a greater abundance of the goods and services we desire. But in the long run, every rise in consumption rates speeds up the already rapid depletion of our land and other resources.

Activities

1. Have interested students debate the following: "The basis of contemporary American culture is consumption."

2. Based on the Brown, Boulding, or Callahan readings listed in the References, have the class discuss the concept of the interdependence of the human ecosystem. Where does the United States fit in? To what degree is the U.S. responsible for world population pressure?

3. Have students obtain their local community's or city's plan for the future. If a local plan is not available, send for information on Reston, Va., or Columbia, Md. (two new planned communities). Address requests to—

The Rouse Company
American Cities Building
Columbia, Md. 21043

Houston Park, Inc.
1930 Isaac Newton Square, East
Reston, Va. 22070

How are increased numbers of people provided for in the plan? What increases in natural resources are required? How much land is required for public use (highways, recreation areas, etc.)? For private living? What new zoning laws will be necessary?

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Concept 3

With growing numbers and concentrations of people, our social lives become increasingly complex. Urban living brings a wider range and greater frequency of interpersonal contact and, in addition, more intensive competition for resources—both physical (e.g., space, raw materials, air, water) and social (e.g., health care, education).

Discussion

In attempting to measure the effects of greater concentrations of people, it is important first to understand the complexities of socioeconomic-ecological relationships. The concept of external costs or "externalities" is frequently involved. Externalities arise when a deal between, or a decision by, parties A and B has a series of indirect consequences that affect the welfare of parties C, D, E, and others. For example, air and noise pollution, auto graveyards, traffic jams, and the paving of land for highways and parking lots are all externalities arising from the private agreements between thousands of auto purchasers and auto dealers.

In metropolitan areas the need for controls over mass transportation is already evident, even at our present population size. The question is, How much longer can the individual be allowed to choose the kind of transportation he will take to work or shopping? Automobiles can move people at one-seventh the rate of buses and only one-twentieth the rate of rail transport. It seems certain that as cities strive to adjust to their growing populations, the individual freedom of movement provided by the private automobile will eventually have to give way to more efficient means of public transportation.

Already we are burdened with traffic laws, building codes, pollution ordinances, and zoning laws. In 70 to 100 years, if the U.S. population doubles as predicted, it is not difficult to foresee even more stringent regimentation. In the use of land, for example, planners have proposed that we (a) set up public corporations to buy up land and hold it until conditions warrant its resale for the most profitable use; (b) extend the size of present governmental landholdings to include the most desirable areas for agriculture, watersheds, greenbelts, and recreation; and (c) require that suburban developments exhaust the acreage least suited to agriculture before developing farmland.

Social planners should be among the first to recognize that with an increasing population, increasing regimentation is necessary to ensure efficiency in the use and distribution of scarce resources, and the predictability in relationships that makes planning possible.

Activities

1. At the beginning of the course, have the class begin to organize a school assembly on "Limitations of Freedom Resulting from an Expanding Affluent Society." Encourage the creation of slide shows, plays, poems, etc. Heavy emphasis should be placed on the controversy over the "freedom" of couples to have as many children as they can be responsible for, versus other degrees of freedom as defined by Hegel ("Freedom is the recognition of necessity").

2. Have students debate the following rights proposed by Dr. Preston Cloud, chairman of the National Academy of Sciences' Committee on Resources and Man, at a 1969 Congressional subcommittee hearing:

> The right of the fetus not to be conceived or if conceived, not born into a world where its presence assures additional misery and privation. It seems . . . uncivilized to consider babies as things that people are entitled to propagate at will, regardless of the kind of life the growing child and adult is likely to live.
>
> The right of society as a whole to determine the density of population that best assures a continuing flexibility of options and access to necessary resources of food, clean air and water, recreation, and essential raw materials. (Cloud 1969, pp. 6-7)

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Concept 4

Because certain resources are finite, all human elements dependent upon them for survival within the ecological system must adjust to their limitations.

Discussion

To increase the output of food, energy, wood products, minerals, and other raw materials so as to provide the same world consumption levels in the year 2000 as prevailed in the 1950-60 period would involve—

- A quadrupling of aggregate food output, including an adequate supply of proteins and vitamins.
- About a fivefold increase in energy output.
- Perhaps as much as a sixfold increase in the output of iron ore and ferroalloys, a somewhat smaller increase in copper, and a very much larger increase in bauxite aluminum.
- A possible quadrupling of lumber output, and a sevenfold increase in pulpwood. (Fisher and Potter 1969, p. 114)

Because so many of the natural resources required to satisfy our food, shelter, energy, and recreation needs are limited, adjustments must be made in our social units if we are to maintain a relatively balanced system. These adjustments may take the form of declines either in consumption rates or in population growth rates.

But consumption rates all over the world are *rising,* as people in poor societies attempt to move from a subsistence level to a life-style better suited to the development of human potential, both physical and mental. It seems likely, then, that the adjustment in the ecological system will come about through a decline in population growth rates. Such a decline can be achieved in either of two ways: (a) If we ignore the imbalances caused by growth and consumption, death rates will eventually rise in response to environmental stress factors. (b) On the other hand, if we set about a conscious effort to limit fertility and to redistribute people and wealth, we can stabilize growth and share an improved quality of life.

Activities

1. Organize a class debate on the priorities of most societies, as shown by their relative expenditures for death control and birth control. In 1965, for example, our National Institutes of Health spent $800 million on death control and $1 million on birth control. Use *Who Shall Live?* as a resource (see References).

2. Discuss the following quotation in class:

> Problems of immediacy always have the advantage of attracting notice—those that lie in the future fare poorly in the competition for attention and money. (John F. Kennedy, 1961)

3. Bring in a scientist who espouses the view that technology can deal adequately with the pressure of growing population on the environment. Ask students to come prepared with information with which to challenge and support this view.

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Filmstrip

Issues in Population: Where the Experts Disagree. 28 min., b & w. (Also available in slide form.) A-V Productions, International Population Program, Social Science Building, Cornell University, Ithaca, N.Y. 14850. 1972. *Attempts to show that controversies among experts do exist and that there are no easy answers.*

Films

Modern Women: The Uneasy Life. 60 min., 16mm, b & w. Indiana University, Audio-Visual Center, Bloomington, Ind. 47401. 1967 *Focuses on problems faced by women who are familiar with and prefer life outside the home. Highlights the value conflict experienced by educated women who attempt to combine a career with the traditional homemaker role. Focuses on different teaching approaches with young girls and what kinds of behavior the various approaches reinforce.*

The Day Before Tomorrow. 25 min. and 51 min. versions, 16mm, color. Associated Sterling Films, 600 Grand Ave., Ridgefield, N.J. 07657. 1971. *Presents history of population growth patterns, emphasizing present rapid growth in U.S. and world. Shows birth control as the first step in controlling growth; describes various birth control techniques. Calls for sex education and responsible sexual behavior. A heavy push for Planned Parenthood organization.*

Tomorrow's Children. 17 min., 16mm, color. Perennial Education, 1825 Willow Rd., Northfield, Ill. 60093. 1971. *Strong but accurate indictment of man's refusal to follow nature's laws of balance. Shows our potential for responding to the physical and psychological needs of our future children through control of both our consumption and reproduction patterns.*

House of Man: Our Changing Environment. 17 min., 16mm, color. Encyclopaedia Britannica Educational Corporation, Rental Library, 1822 Pickwick Ave., Glenview, Ill. 60025. 1965. *Contrasts the natural ecosystem of a pond with man's environment, the city. Questions whether the problems of urban sprawl, pollution, and slums must be the perpetual legacy of the Industrial Age. Shows planning as the key to breaking this legacy. The film's strong points are its tracing of the history of world population growth and resource use and its presentation of a value orientation other than the economic one.*

The Population Problem: India, Writings in the Sand. 60 min., 16mm, color. Indiana University, Audio-Visual Center, Bloomington, Ind. 47401. 1964. *Details the effects of India's uncontrolled population growth on her economy, focusing on cultural and religious resistance to change. Interviews show upper and middle classes and governmental officials very concerned over too rapid growth. Gives basic understanding of causes and consequences of population growth in Indian society.*

The Population Problem: Japan, Answer in the Orient. 60 min., 16mm, color. Indiana University, Audio-Visual Center, Bloomington, Ind. 47401. 1966. *Historical and sociological view of Japan, focusing on population change. Describes relationship of population growth to Japan's military conquests and expansion in the past 100 years. Explains how abortion has helped slow population growth and how contraception and late marriage may be replacing abortion as methods of birth control. Last third of film follows modern economic and societal change: food and energy production, breakdown in traditional family customs, etc.*

The Population Problem: The USA, Seeds of Change. 30 min., 16mm, b & w. Indiana University, Audio-Visual Center, Bloomington, Ind. 47401. 1966. *Focuses on societal problems of congestion, commuting, inner-city life, migration to the suburbs, loss of fertile land, poverty, inadequate recreation and education facilities, as they are affected by population growth. Points directly to the need for the U.S. to respond to its own population pressure.*

To Each a Rightful Share. 30 min., 16mm, b & w. McGraw-Hill, Film Preview Library, Princeton Rd., Highstown, N.J. 08520. 1961. *Contrasts the "have" and "have-not" nations in the battle for strategic resources. Shows Western man's wasteful use of these resources.*

Tragedy of the Commons. 23 min., 16mm, color. King Screen Productions, 320 Aurora Ave., N., Seattle, Wash. 98109. 1971. *Shows population growth first through analogy with the overgrazed common pastureland, then through examination of the degradation of urban life. Brings attention to black people's mistrust of the entire ecology/population movement. States clearly that population must be controlled.*

The Mounting Millions. 60 min., 16mm, b & w. Indiana University, Audio-Visual Center, Bloomington, Ind. 47401. 1969. *Focuses on India's need for economic and agricultural development and social change. Shows how population growth makes progress in these areas difficult. Special emphasis on alternative solutions to the problem of food production shortages.*

The Time of Man. 50 min., 16mm, color. Holt, Rinehart and Winston, Media Sales, 383 Madison Ave., New York, N.Y. 10017. 1971. *Reviews human evolutionary history from an anthropological perspective; looks at primates in their natural surroundings; studies primitive populations in Africa and New Guinea to show how man can interact with his environment without causing severe imbalances. Main theme is our reliance on a supportive ecosystem. Concludes with a 10-minute flashback on human intrusions into natural systems over the last 60 years. Stresses population stabilization as a necessary step in regaining balance.*

Appendix A

Population Statistics: What Do They Mean?

(Reprinted with the permission of the Population Reference Bureau, Inc., from its March 1972 Population Profile)

An exchange of letters took place recently in the Portland (Oregon) Press between a local resident and a representative of the Portland chapter of Zero Population Growth, Inc. At one point in the exchange the citizen asked: "Shall we use ZPG's statistics or those I used from the Census Bureau. . . ?" The ZPG man was quick to respond that he used Census Bureau statistics, too.

The episode is typical of the confusion that is generated when complex, controversial subjects are discussed in terms of numbers. Statistics are powerful weapons in a controversy; all too often they are used improperly, inaccurately, and even dishonestly. Those who wish to understand a subject, and to judge the merits of opposing views, must be able to spot the occasions when statistics are used incorrectly. Those who wish to take part in, or report on, a controversial subject have a further task: to make sure the numbers they quote are both accurate and appropriate to the point being made.

The major purpose of most population statistics is to describe how populations have changed and are changing, and—most difficult but also most interesting—how they will change in the future. Demographers have developed a number of measures to describe the behavior of populations. Each has advantages—and defects. This Profile outlines the most common measures of population dynamics, and indicates how they can most profitably be used.

There is another side to demographic statistics that, unless it is continually kept in mind, can also be misleading. That is the question of accuracy. Demographers are constantly aware that the numbers they use may not be very reliable, but sometimes laymen forget it. Even in advanced countries where statistics have been collected for many years, the accuracy of numbers that represent the behavior of millions of people often is open to question. And sometimes, especially for indicators based on sophisticated computations, available figures can be outdated.

Population Indicators

A good way to illustrate both the quality of demographic data and some of the major demographic measures is to describe how one of the simplest figures—the total national population—is developed. The basic measures used for estimating total population come from the NATIONAL CENSUS. Most countries today—there are some notable exceptions including the world's most populous country, China—conduct population censuses on a fairly regular basis. Some censuses collect information on a broad range of subjects, while others are aimed simply at counting the number of people in the country at a given time.

If a national census involves a genuine effort to count every person, rather than just estimating populations on a regional basis, the most common error is likely to result from the fact that some people just didn't get counted.

The size of the undercount may be estimated by conducting a post-census survey in which a representative sample is asked whether they were counted during the census. The proportion of those sampled who had not been counted gives an estimate of the size of the undercount. In the 1960 U.S. Census, for example, the undercount was estimated to be 3 percent, or almost 6 million people. The estimate of the 1970 census undercount has not yet been made by the Census Bureau.

A census gives a more or less accurate estimate of the number of people in a country at one point in time. But censuses are taken too seldom to be satisfactory for many uses. Often, estimates are needed of the population at times between censuses.

One way of making such estimates is to use the INTERCENSAL GROWTH RATE. This figure is computed by subtracting the population figure of the previous census from that of the current census, which yields the intercensal population growth. In the United States, for example, the 1970 Census population was 203 million, and the 1960 population was 179 million.

$$\textit{Intercensal growth} = \textit{[1970 population]} - \textit{[1960 population]}$$

This figure is converted to an average annual growth RATE by dividing it by the number of years between censuses (10 years in the case of the U.S.) and dividing the result by the total population of the earlier census year:

$$\textit{Average annual growth rate} = \frac{\dfrac{\textit{Intercensal growth}}{\textit{Years between censuses}}}{\textit{Earlier (1960) population}}$$

$$= \frac{\dfrac{\textit{24 million}}{\textit{10}}}{\textit{179 million}}$$

$$= \textit{1.3 percent per year}$$

The growth rate can be used to make a rough estimate of the population in the years between censuses. If the population had continued to grow at 1.3 percent per year through 1971, then the population for that year would be 1.3 percent greater than the 1970 figure, for a total of 207 million.

This estimate is based on a statistical projection of the 1970 population in which it is assumed that the population continued to grow at 1.3 percent. Most such projections of where a population is going are based on an assumption of this sort: that the rate of change will remain the same as it was when last measured (or that it will vary in a certain way). Rates can change unpredictably, however. A given rate is accurate only at the time it is measured. Any extension beyond that period, especially for more than a short time, is open to error.

Another way to estimate population between censuses involves the use of three other measures:

The CRUDE BIRTH RATE measures the number of babies born in one year for each 1,000 persons in the population at the midpoint of that same year:

$$\textit{Birth rate} = \frac{\textit{Number of births per year}}{\textit{Population}} \times \textit{1000}$$

Similarly, the CRUDE DEATH RATE is the number of deaths in one year per 1,000 population:

$$\textit{Death rate} = \frac{\textit{Number of deaths per year}}{\textit{Population}} \times \textit{1000}$$

NET MIGRATION is the difference between the number of people who enter the country in one year (immigration) and the number who leave (emigration):

$$\textit{Net migration} = \textit{Immigration} - \textit{emigration}$$

Net migration can be either positive, with more immigrants than emigrants, or negative, with more people leaving than entering.

All three of these measures are complicated and difficult to obtain, especially for the less developed countries. They require that up-to-date birth and death records be kept on the local

level, and that the results be forwarded to a central authority for integration on a national basis. Even in the United States, it was not until 1933 that all the states joined the federal system of birth and death registration, and many countries still do not have national systems.

Still, even partial registration can be used to estimate birth and death rates, and together these two indicators give a measure of the NATURAL INCREASE of a country (excluding migration):

$$\text{Rate of natural increase} = \frac{[\text{Birth rate} - \text{death rate}]}{10}$$

Since birth and death rates are measured as so-many per 1,000 population, the difference is divided by 10 to yield increase per 100 population, or percent.

In the United States in 1970, the birth rate was 18 per 1,000, and the death rate was 9 per 1,000. That means that the rate of natural increase was (18-9)/10 = 0.9 percent.

Net migration can be converted to a "per-1,000" figure and added into the equation to yield the GROWTH RATE:

$$\text{Growth rate} = \frac{[\text{Birth rate} - \text{death rate}] + \frac{\text{Net migration}}{\text{population}} \times 1000}{10}$$

In the United States in 1970, net migration was 400,000, or 2 per 1,000 population. So the total growth rate was (18 − 9 + 2)/10 = 1.1 percent.

This figure can be compared with the average annual Intercensal Growth Rate computed earlier. That figure was 1.3 percent; so the annual population growth rate in the United States has dropped compared with the average rate during the 1960s.

For projections of population growth over more than a year or two, demographers like to have even more detailed indicators than births and deaths. Most of these measures depend on a knowledge of the AGE STRUCTURE of a population.

Age structure has significant effects on population growth. Basically, the rate of natural increase depends on two factors: the rate at which women in the reproductive age group are having babies, called FERTILITY, and the proportion of women who are in the childbearing period of their lives. In the United States, for instance, the children born during the high-fertility years of the 1950s, more numerous than those born in the previous decade, will be entering the ranks of parents during the 1970s and 1980s. Even if fertility remains at its present low level, the number of babies born per 1,000 total population—the birth rate—is likely to be higher. Fertility would have to drop below present levels for the birth rate to remain unchanged.

Fertility is measured in several different ways. Each has advantages and disadvantages which make it more or less useful in projecting future population growth.

GENERAL FERTILITY is the number of children born each year per 1,000 women in the reproductive age group (15 to 44 years in the United States). This measure takes the age structure into account to a certain extent, unlike the birth rate. In 1971 the general fertility rate was 82.3 births per 1,000 women. If general fertility stayed at that level for 30 years, the length of the reproductive cycle, that measure would correspond to 30 × 82.3 = 2469 births per 1,000 women, or 2.47 births per woman. But that is a highly artificial measure, since it assumes constant fertility and does not reflect changes in the age structure. For this reason, while the general fertility rate is used to measure changes in current fertility, other indicators are computed to reflect longer term fertility trends.

The AGE-SPECIFIC FERTILITY RATE eliminates the effect of age structure entirely; it is the number of births per year to 1,000 women of a particular age. It can be computed (if the data are available) for each single year of age during the reproductive years, but it is usually computed for five-year age groups: women 15-19 years old, 20-24 years, 25-29 years, and so on.

The TOTAL FERTILITY RATE is based on age-specific rates. It measures the total number of children 1,000 women would have if they passed through their reproductive years with the

age-specific fertility of a particular year. For example, in 1968 the fertility rate for women aged 15-19 years in the U.S. was 66 births per 1,000; for women aged 20-24 it was 167, and for women aged 25-29 it was 140.

To compute the total fertility rate for 1968, a demographer would assume that 1,000 women would have 66 births per year between the times when they were 15 and 19, 167 births per year between the ages 20 to 24, 140 births per year between ages 25 and 29, and so on, corresponding to the fertility rates that existed for each age group in that one year, 1968.

Naturally, no group of 1,000 women is going to experience exactly the fertility pattern assumed in computing the total fertility rate. Age-specific fertility is likely to change over the 30 years required for a group of women to pass through their fertile period. So the total fertility rate is hypothetical. It is another of those measures that need the warning phrase: "If present rates continue."

There is a fertility measure that, unlike the total fertility rate, measures the number of children a group of 1,000 women have actually had. That is called the COMPLETED FERTILITY RATE. It measures the total number of children born to women who reach the end of their reproductive cycle in the year the measure is taken. In the United States in 1968, the completed fertility rate for women aged 44 was 2.7 per 1,000 women.

At first glance it might seem that completed fertility would be a much more reliable indicator than the unreal figure represented by the total fertility rate. The difficulty is that most children are born to women in their 20s; so the completed fertility figure measures the child-bearing behavior of women who had most of their children 20 years earlier. This makes it much less useful for estimating what fertility behavior is like at present, or is going to be like in the future.

Zero Growth—The Replacement Level

Much of the discussion going on about population today is concerned with the question of population growth, and especially with the question of zero population growth. Using the indicators described in the previous section, what can be said about halting population growth in this country?

Some recent reports, drawing on declines in the birth rate and in fertility, suggest that zero population growth might be just around the corner. But a further look at the statistics, in the light of their limitations, shows that this possibility is remote.

What is zero growth? Basically, it is a condition under which the birth rate is equal to the death rate (ignoring the effects of net migration).

Obviously, with the current 1971 birth rate at 17 per 1,000 and the death rate at 9 per 1,000, the country is nowhere near ZPG. Its rate of natural increase is 8 per 1,000 or 0.8 percent per year, a net increase in the U.S. population of about 1.7 million people per year. In fact, as far as is known, birth rates have never declined to close to the level of the death rate in the United States, even during the low fertility period of the 1930s.

But birth and death rates, although they accurately reflect present population conditions, are poor predictors of the future. This is because they are so sensitive to variations in the age structure, and because fertility behavior can change rapidly.

Replacement Level of Fertility

So the next step is to look at fertility rates. Demographers have calculated that if women have a completed fertility rate of 2.11 children, there will be enough births to replace the parents and compensate for premature deaths. This figure, 2.11, is called the REPLACEMENT LEVEL of fertility.

Completed fertility for the cohort of women who came out of their childbearing years in the 1970s (born 1925-1929) will be over 3. Quite clearly, this cohort was nowhere near the replacement level of fertility. But it has already been noted that the completed fertility applies

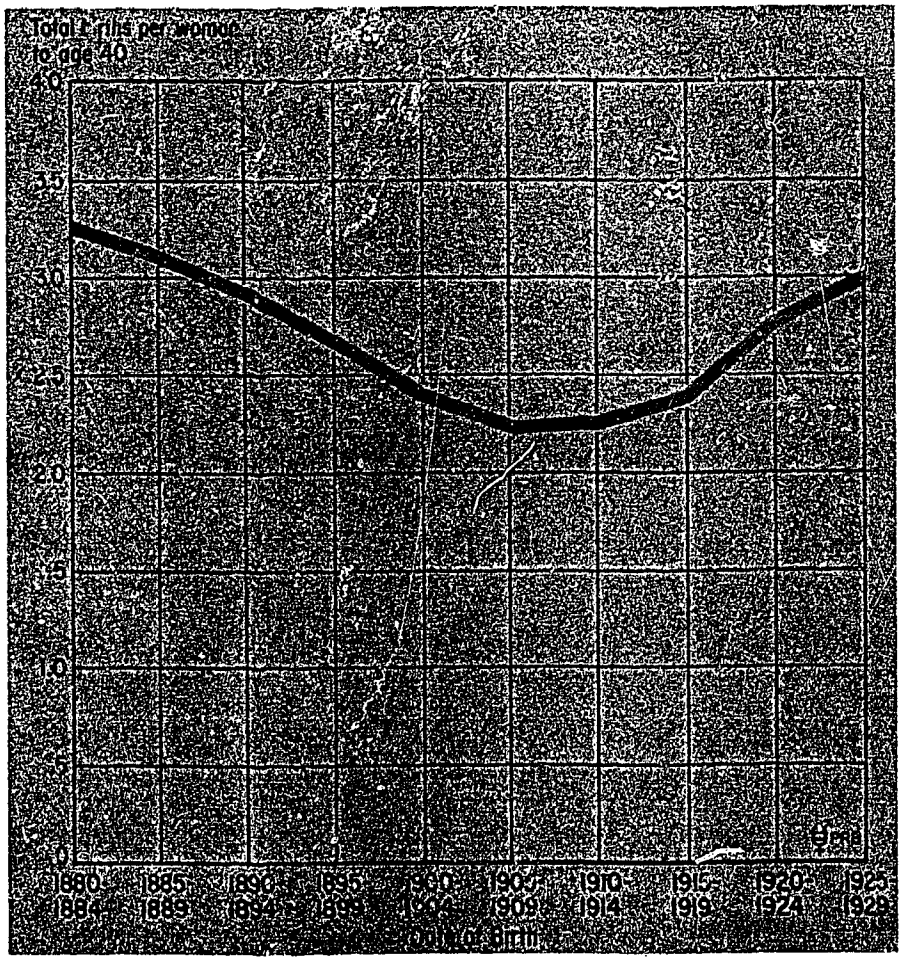
to woman who were doing most of their childbearing 15 or 20 years earlier. It can tell what fertility behavior was in the past, but it is not very informative about present fertility behavior, and almost useless in projecting future behavior.

The measure of total fertility would seem to be more useful, since it deals with current fertility patterns. In computing total fertility, it is assumed that women just entering the reproductive years will follow the age-specific fertility pattern for a given year. If this age-specific pattern remains the same throughout the 30 years of their reproductive cycle, these women would have a completed fertility equal to the total fertility that was computed for that given year.

In 1968, the total fertility rate was 2.5. Provisional figures for 1969 and 1970—based on 1968 age-specific fertility rates—are 2.4 and 2.5. In 1957, at the height of the baby boom, the total fertility rate was 3.7. Looking at this decline, there is a temptation to say that fertility is close to the replacement level of 2.11—particularly since general fertility dropped in 1971.

But there are two reasons for resisting this temptation. In the first place, total fertility is only hypothetical. It is based on the assumption that fertility will remain unchanged for 30 years. But age-specific fertility could go up during that period; it could go down. Age at marriage could change; so could the spacing of children born. It could increase at the higher age levels

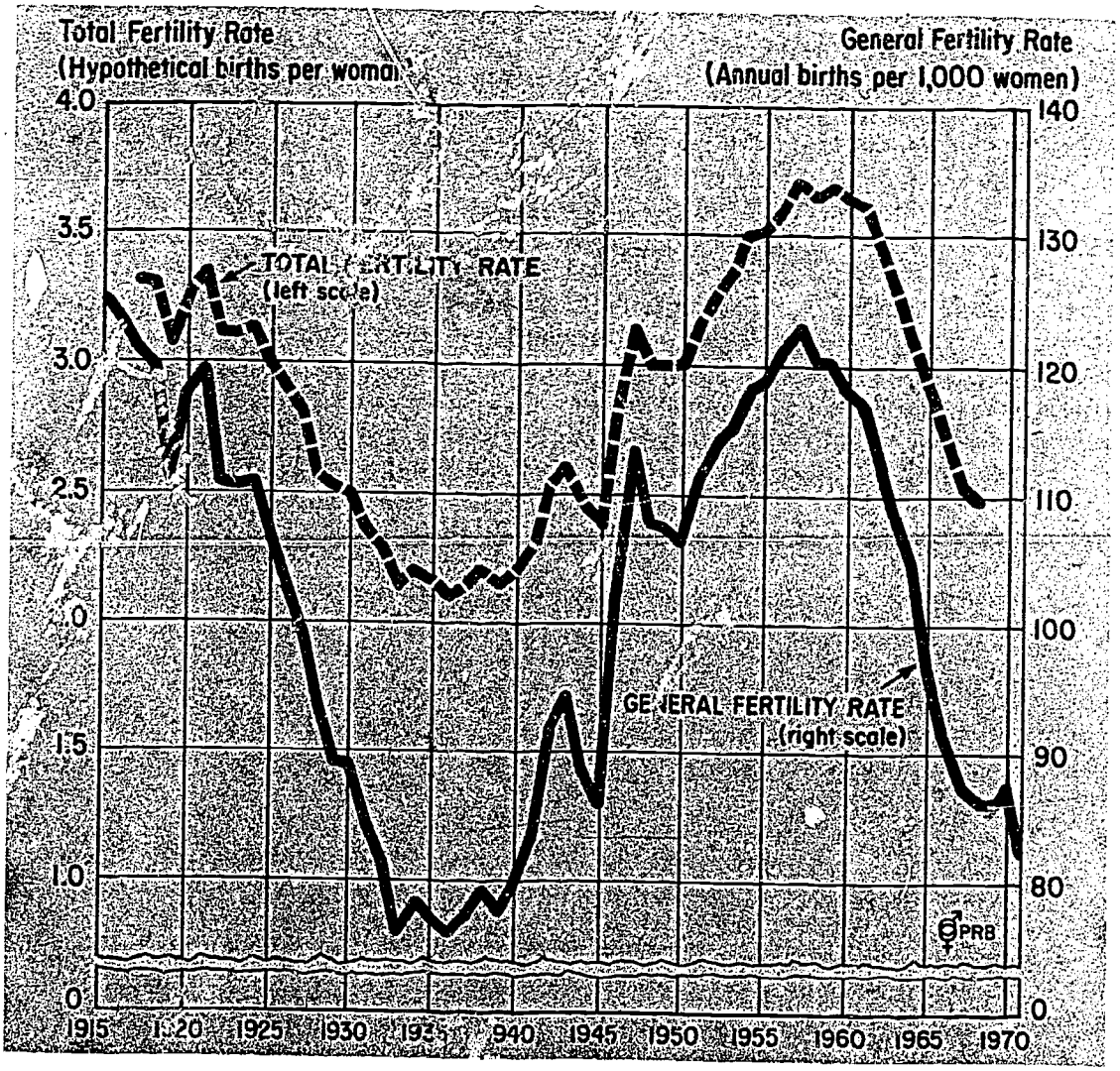
CHILDREN EVER BORN TO AGE 40, FOR WOMEN BORN 1880-1929



Source: National Center for Health Statistics.

Completed Fertility decreased for women who did most of their childbearing in the 1930s, increased for post-World War II mothers.

TOTAL FERTILITY AND GENERAL FERTILITY, 1915-1971



Source: National Center for Health Statistics.
The decrease in fertility since the baby boom peak of 1957 parallels the earlier decline of the 1920s and early 1930s.

and decrease at the younger ages, or vice-versa. Fertility behavior is so greatly influenced by complex social, economic and psychological factors that predicting its future course is extremely chancy.

The other reason for hesitancy is that the total fertility rate is out of date. For several reasons, particularly budgetary ones, the National Center for Health Statistics has fallen behind in computing data on age-specific fertility, so that the latest available figures are for 1968 (with provisional 1969 and 1970 figures). The lag in this important indicator is particularly unfortunate because of the controversy currently surrounding population questions.

The general fertility rate, the number of children born each year per 1,000 reproductive-age women, is more current: The provisional figure for 1971, 82.3, has already been published. General fertility, as has been shown, is a better indicator of childbearing activity than the birth rate, because it takes the age structure into account. But if total fertility is a chancy tool for estimating future population trends, the general fertility rate is even more unreliable.

U.S. Population—Where It's At

The previous section was concerned with the limitations on what can be gleaned from population statistics. The general conclusion was that it is impossible to say with certainty at this time how close fertility is to the replacement level, and most unwise to predict when replacement will be reached. It is even less advisable to predict how soon population growth will end.

But some conclusions can indeed be drawn about current fertility behavior, based on data available. At the least, what is known about the present can be compared with the fuller details that have been collected for earlier periods.

Completed fertility measures the childbearing behavior of women coming out of their reproductive years. The most convenient figure to use is the total number of children born to women up to the age of 40, since few children are born beyond that age. The curve shows that women who were born in 1885 to 1889, and who were at peak fertility just before World War I, were averaging more than three births each by age 40. Twenty years later, in the 1930s, women in their peak fertility years were bearing fewer children: The average fertility by age 40 for this group was a little more than two births per woman. Early in the 1950s, fertility was up again: the group that was in its 20s in those years reached an average of three births per woman at age 40.

The trend traced by the completed fertility curve is also reflected in the total fertility indicator, which was higher than three children per woman in the early 1920s, dipped to 2.2 children in the late 1930s, and rose to 3.7 children in the late 1950s. Since then, the total fertility rate shows a decline; in 1968, the latest figure available, it was 2.48 children per woman.

The general fertility rate similarly reflects these changes. In the early 1920s it was well above 100 births per 1,000 women in the reproductive age groups. It fell below 80 during the 1930s, then rose to a peak of 121 in the late 1950s. Since then it has decreased, reaching 82.3 in 1971.

These trends show that fertility has declined dramatically in the 14 years since general fertility peaked in 1957. But a look at history shows that the decline was equally dramatic in the 12 years from 1921 to 1933. General fertility has not yet reached the low point of the 1930s, when it remained below 80 per 1,000 for eight years.

What about replacement fertility and zero population growth? The total fertility rate for the low years of the 1930s was very close to the replacement level. Despite these low levels, however, the country was never close to zero population growth. The baby boom that took place in the 1940s and 1950s, and continued well into the 1960s, sent the population growth rate up a steep incline.

Nor is the country close to zero growth today. Fertility has not fallen to the levels of the 1930s; even if it does, it will take many years of sustained low fertility to overcome the effects of the relatively large number of people now entering the reproductive period of their lives.

Population Projections

The decline in fertility since the late 1950s has not been ignored by those attempting to predict future U.S. population trends. Rapid changes in fertility place a heavy burden on the economy and on the society. The sharp increase in childbearing during the baby boom years put a severe strain on schools, once these children reached their sixth year; likewise, a substantial decrease in the young age groups would require adjustments in education, health and other services.

As a result, there has been much controversy over the significance of the fertility decline of the 1960s, accompanied by some dubious manipulation of population statistics on the part of a few participants. One highly publicized report by a private research firm extended the current

fertility decline downward through the 1970s and announced that the nation was in danger of "Instant ZPG"—vaguely defined as zero growth within a decade or a few decades.

Warnings of this kind are contradicted by the population projections released by the U.S. Census Bureau. Their main technique in making projections—the current series includes four, labeled Series B, C, D and E—is to assume that fertility will follow various paths, and to compute how population will change, given the present age structure, certain factors of mortality and immigration levels. Series B, the highest fertility assumption, is based on a level of 3.1 children per woman; Series E, the lowest, assumes that fertility will decline gradually to reach replacement, 2.11, in the year 2000. Another Series, labelled X, is the same as Series E but assumes that net immigration will be zero.

Under Series X assumptions, zero growth would not be reached until the year 2037, at which time U.S. population would be 276 million, 67 million greater than at present.

Below Replacement Fertility

What if fertility dropped below replacement? Such fertility behavior has never happened before, but there is nothing to prevent such an event, and there are a number of forces, including better contraceptives, easier access to abortion, economic factors, and environmental concerns, that could push fertility down.

In response to such speculation the Census Bureau has issued a new series of "illustrative" projections with lower fertility assumptions than Series E. There are 12 projections in the new series, six assuming no net immigration, and six assuming an annual net immigration of 400,000 (the same as for Series B through E).

The Census Bureau has not issued these new projections as a substitute for the Series B-through-E curves. Rather, they are illustrations of what could be expected under what seem to be rather unrealistic assumptions (although some of them would appear to be more realistic than the Series B projection, with its assumption of a fertility of 3.1 children).

Two of the new projections, Series T and Series W, assume that fertility will drop to replacement by 1980 and 1970 respectively. Series V assumes that fertility will continue its downward course to reach a level of 1.5 by 1980, and then increase to reach replacement by the year 2000.

These projections show that even if fertility continues to decrease considerably below replacement, as in Series V, population growth would continue well into the 21st century, although it would have slowed substantially by the year 2000. Assuming no net immigration, population under Series V assumptions would be 240 million in 2000, and 254 million in 2030. With an annual net immigration of 400,000, population would be 255 million by the year 2000 and 287 million by 2030, according to the Series V projection.

Conclusion

The future course of population growth is vitally important to the economic and social well-being of America. Providing public services such as schools and health care; predicting future markets for everything from toys to automobiles and housing; planning for urban growth—all these activities are affected by how many people there are, and how many there will be.

But projecting future population, as this Profile shows, is not an easy task. The spread between the Census Bureau's Series B projection and its "illustrative" Series V curve is almost 100 million people by the year 2000—less than 30 years in the future. The spread becomes almost 200 million—close to the present total U.S. population—by the year 2020. Both of these extreme projections are unlikely, but neither is unreasonable. And their reasonableness makes the planning task of those responsible for preparing for the future much harder.

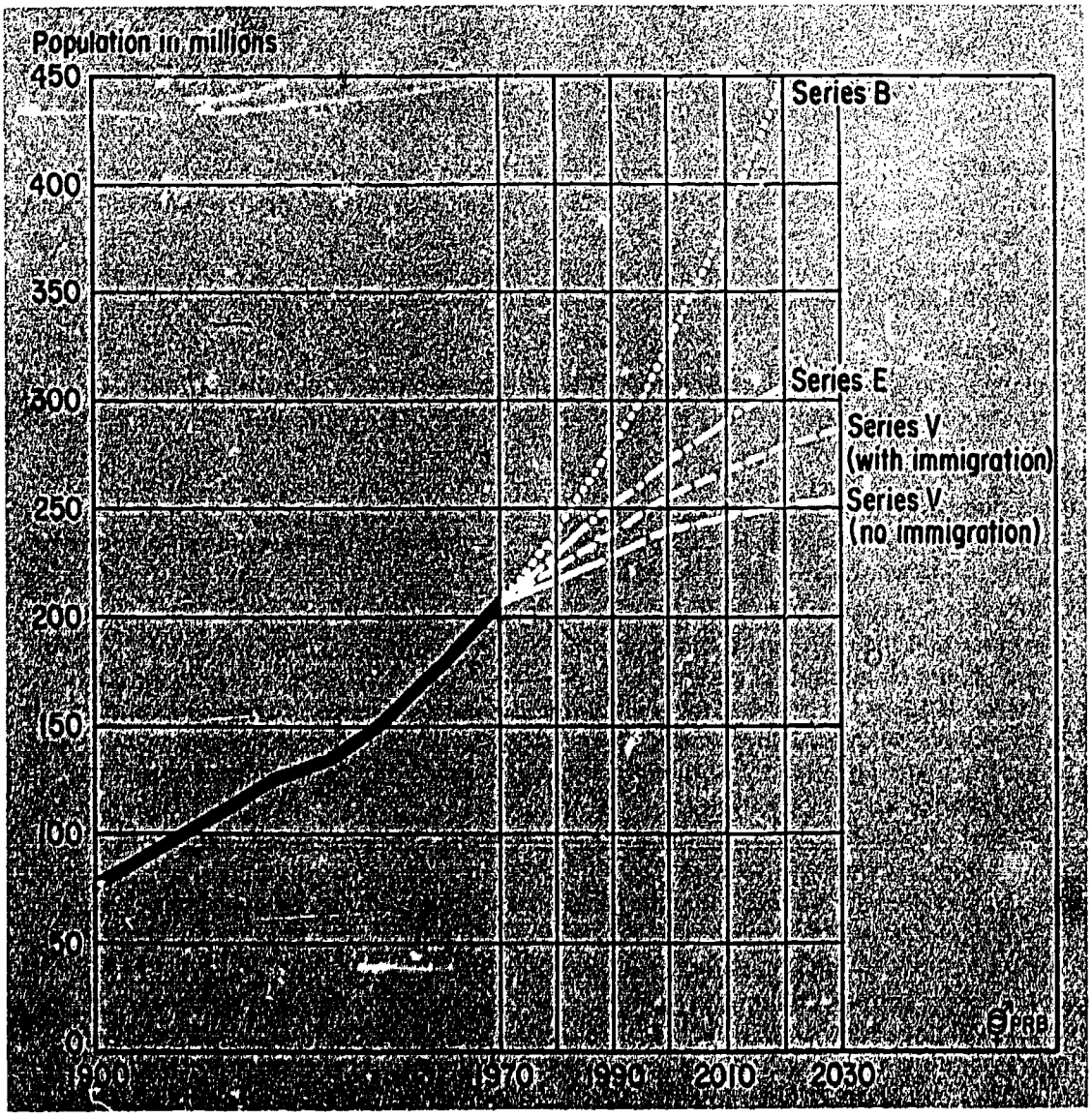
The projections prepared by the Census Bureau, and the anal[illegible], show one fact: that the threat of "Instant ZPG" is a remote one. Populati[illegible]ly likely to continue for many years, even if fertility rates remain at prese[illegible]ven further.

At the same time, there is strong evidence that population growth is likely to come to an end in the future, perhaps within the lifetime of many of those being born today. Although there will be many adjustments to be made in the economy and the society as a result of this trend, there will be time to adjust to them. And there are also many benefits to be derived from a reduction in population growth.

As the Commission on Population Growth and the American Future put it in its final report of March, 1972:

"The nation should welcome and plan for a stabilized population."

PROJECTED POPULATION GROWTH, VARYING FERTILITY ASSUMPTIONS, TO 2030



Source: U.S. Bureau of the Census.

Even if fertility drops well below replacement, as in the Census Bureau's Series V projection, population growth will continue well into the 21st century.

Appendix B

Presidential Statements on Population

Dwight D. Eisenhower

"I cannot imagine anything more emphatically a subject that is not a proper political or governmental activity . . . this government will not . . . as long as I am here, have a positive political doctrine in its program that has to do with this problem of birth control. That's not our business."—*News conference, March 22, 1960*

"When I was President I opposed the use of federal funds to provide birth control information to countries we were aiding because I felt this would violate the deepest religious convictions of large groups of taxpayers. As I now look back it may be that I was carrying that conviction too far. I still believe that as a national policy we should not make birth control programs a condition to our foreign aid but we should tell receiving nations how population growth threatens them and what can be done about it."—*Saturday Evening Post, 1963*

John F. Kennedy

"The magnitude of the problem is staggering. In Latin America, for example, population growth is already threatening to outpace economic growth. And in some parts of the continent, living standards are actually declining . . . and the problems are no less serious or demanding in other developing parts of the world."—*Special Message on Foreign Aid, 1961*

Lyndon B. Johnson

"I will seek new ways to use our knowledge to help deal with the explosion in world population and the growing scarcity of world resources."—*State of the Union Message, January 4, 1965*

Richard M. Nixon

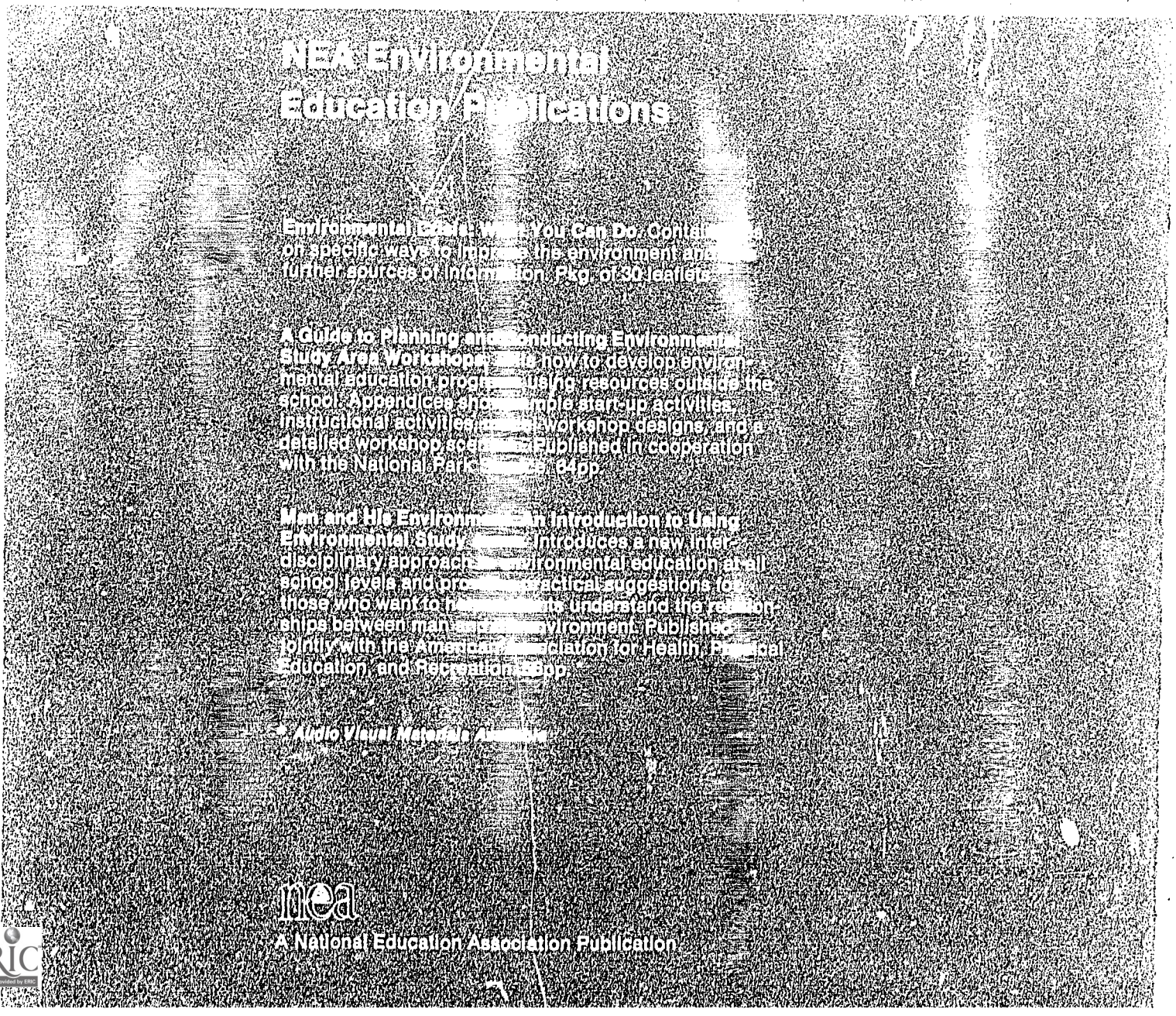
"I today propose the creation by Congress of a Commission on Population Growth and the American Future . . . a number of additional government activities dealing with population growth . . . need not await the report of the Commission.

"First, increased research is essential. . . .

". . . it is clear that the domestic family planning services supported by the Federal Government should be expanded and better integrated. . . . It is my view that no American woman should be denied access to family planning assistance because of her economic condition. I believe, therefore, that we should establish as a national goal the provision of adequate family planning services within the next five years to all those who want them but cannot afford them.

". . . the United Nations . . . and other international bodies should take the leadership in responding to world population growth. The United States will cooperate fully with their programs . . . I have asked the Secretary of State and the Administrator of the Agency for International Development to give population and family planning high priority for attention, personnel, research, and funding among our several aid programs.

"One of the most serious challenges to human destiny in the last third of this century will be the growth of the population. Whether man's response to that challenge will be a cause for pride or for despair in the year 2000 will depend very much on what we do today. If we now begin our work in an appropriate manner, and if we continue to devote a considerable amount of attention and energy to this problem, then mankind will be able to surmount this challenge as it has surmounted so many during the long march of civilization."—*Presidential Message on Population, July 18, 1969*



version of the unit utilized the FIRM format of material organization (See Appendix H), and the second followed the more traditional structure of a written narrative supplemented with graphic illustrations (See Appendix I).

Hypotheses

The parallel versions of the unit referred to in Question 2 provided the basis for testing the research and statistical hypotheses. The three research hypotheses tested in this experiment were:

1. Subjects using the Forced Inferential Response Mode treatment materials will score significantly higher on the researcher-constructed criterion posttest than the students that use the same content materials presented in the form of a written narrative when adjustments are made for initial differences in vocabulary, map reading, and graph reading skills.

2. Subjects using the Forced Inferential Response Mode treatment materials will score significantly higher on a standardized posttest of map reading skills than the students that use the same content materials presented in the form of a written narrative when adjustments are made for initial differences in map reading skills.

3. Subjects using the Forced Inferential Response Mode treatment materials will score significantly higher on a standardized posttest of graph reading skills than the students that use the same content materials presented in the form of a written narrative when adjustments are made for initial differences in graph reading skills.

These three research hypotheses were tested at the fifth, sixth, and seventh grade levels.

The three statistical hypotheses tested in this experiment were:

1. There will be no significant difference in scores on a researcher-constructed criterion posttest between the treatment groups when adjustments are made for initial differences in vocabulary, map reading, and graph reading skills.

2. There will be no significant difference in scores on a standardized posttest of map reading skills between the treatment groups when adjustments are made for initial differences in map reading skills.

3. There will be no significant difference in scores on a standardized posttest of graph reading skills between the treatment groups when adjustments are made for initial differences in graph reading skills.

These three statistical hypotheses were tested at the fifth, sixth, and seventh grade levels.

Definition of Terms

The key term in this study is FIRM, an acronym for the Forced Inferential Response Mode, a self-instructional text which uses incomplete sentence stems to force a student to derive information from a data base in order to construct a series of sequential responses. When correctly completed, the stems and the responses compose a logical narrative which interprets information contained in the data base.

This brief description of FIRM shows its relationship to the usual tutorial text. A comparison of FIRM with a programmed text, however, shows that FIRM has a more complex data base in which there are many variables. For example, the key concept of variable population density of the pre-Columbian Indian population of North America is one of many

concepts and facts presented in the data base in Figure 1, page 3, Appendix H. In order to respond to the second stem on facing page 4, the student must be able to select the response "density" from the many variables presented graphically in the data base on page 3.

In contrast, programming normally provides more restrictive cues to the desired response. A simple illustration of this programmed text procedure is taken from the programmed text Evolution (Thomas, 1971, p. 3):

> . . .
>
> EVOLUTION is the word that means the slow change in living things over the years.
>
> . . .
>
> No matter what plants or animals you write down, they have all changed over the years. The change that has taken place is called E V O L ____ __ __ __.
> (fill in blanks)

A comparison of the FIRM with the programmed format suggests that a FIRM response requires the student to use greater skills of perception, discrimination, and the application of previous knowledge. In the programmed format, it appears that the student is more likely required to apply the skill of direct association.

The key words in FIRM are forced, inferential, data base, logical narrative, and progressive complexity. These words are defined in more detail in this section. Other major terms in the study relate to population education and reinforcement.

Data Base: A body of data in which all responses that are to be associated with written stimuli are presented. In this application of FIRM, the data base was composed of various types of maps, charts, graphs, and tables.

Forced Response: Written words or phrases that students elicit as a result of being presented with a particular stimuli. When the correct responses are paired with their associated stimuli, they constitute a logical, written narrative describing one of the demographic or geographic characteristics of the United States or Mexico.

Inferential: A qualifier added to this self-instructional mode because the student does not merely associate unequivocal factual responses with particular stimuli, but rather he is required to infer certain relationships or consequences from the graphical data base in order to correctly complete a stem. This instructional mode requires the student to elicit responses which are selective and interpretive, as well as factual in nature.

Logical Narrative: A conceptual set of S-R associations that when correctly completed, constitute a written essay that describes some demographic or geographic characteristic of the United States or Mexico.

Population Education: The transmission of knowledge about the methods of analyzing population processes, population characteristics, the causes of population change and the consequences of that change for the individual and society (Viederman, 1971).

Progressive Complexity of the Data Base: Initially the data base from which the responses were derived contained graphics of minimal complexity. The intent was to gradually shape the student's ability to make the proper response discrimination. As the unit progressed, the number of variables in the graphics increased and the type of graphics used became more abstract. This process of progressively increasing the difficulty of the data base was intended to improve the student's ability to use such graphic forms.

Response: A written word, phrase, or sentence elicited by the student in association with a given stimulus.

Reinforcement: The strengthening of correct S-R associations derived from the knowledge of having made a correct response. Since this mode was self-instructional in nature, the student was provided with an answer booklet which enabled him to reinforce all correct S-R associations. When incorrect S-R associations were made, reinforcement was withheld until the correct associations were made.

Stem: A form of incomplete sentence. A series of correctly completed stems read in sequence compose a logical narrative.

Stimulus-Response Reinforcement Model: A conceptualization of learning which explains learning as a process of associations which are connected as a result of responses made to stimuli, which become reinforced through internal or external rewards. According to Silverman (1969), the three principles of S-R learning are stimulus, activation, and response, which are discussed in Chapter III.

The implications of the questions raised in this study and the use of the defined terms are elaborated in the review of the literature, subject of the next chapter.

CHAPTER II

REVIEW OF THE LITERATURE

This review of the literature was concerned with two topics pertinent to this study--the relationship of FIRM to S-R theory and the relationship of FIRM to the use of graphics. A third aspect of the review of the literature dealt with the need for middle grade materials in population geography. This aspect of the literature is treated in Chapter III, in connection with materials development.

FIRM: Possible Alternate Form of the S-R Reinforcement Model

The relationship of learning theory to curriculum materials development largely rests upon the logic of the researcher and not the experimental design which tests the appropriateness of the materials or comparative effectiveness. The assertion that a particular curriculum rests upon a particular learning theory is neither confirmed nor rejected by the experimental findings. A curriculum may be appropriate by grade level and facilitative as measured by pupil achievement and still fail to be logically convincing as to the relationship of the alleged theory and its product. The limitations of building curriculum upon a determinant

learning theory are at least two fold: The logic of the researcher may be deficient in translating theory into materials, and his curriculum interpretation of the learning theory may not be subject to independent replication.

With these hazards in mind, it was nevertheless considered important for research within the Geography Curriculum Project to relate the conceptualization of FIRM to learning theory. Based on his analysis of both theoretical formulations of S-R theory and their practical applications in the form of programmed texts, the researcher considers it appropriate to regard FIRM as an alternate form of the S-R reinforcement model.

Programmed instruction is one of the most common applications of the S-R reinforcement model to verbal learning (Bigge, 1964). If these programs rest upon S-R theory, and if FIRM has many of the applied characteristics of these programs, then it appears to follow that FIRM might be interpreted in accordance with the S-R reinforcement model.

A useful point of relating S-R theory to FIRM thus appears to begin with examining the characteristics of programmed instruction. From the standpoint of applied learning procedures, FIRM has several characteristics with programmed instruction. Among these gross similarities are

1. Careful specification of learning outcomes.
2. Task categoric selection of content to facilitate learning outcomes.

3. Presentation of learning tasks in small, organized, sequential steps.

4. Active involvement of the learner, with the learner constructing his own responses from the data supplied.

5. Reinforcement through feedback which allows the learner to monitor his own responses.

6. Differential, self-instructional pacing permits the learner to adjust time in learning to his own learning needs.

The similarity of FIRM to programmed instruction therefore impelled the researcher to examine the relationship of S-R theory to FIRM. Inherent in the S-R reinforcement model is the analysis of student behavior in relation to the association of stimuli and responses. Learning is represented as the change in S-R associations that occur when reinforcement is properly used to strengthen correct S-R pairings (Silverman, 1969).

FIRM presented students with sets of related stimuli in the form of incomplete written sentences. These sentences were constructed and sequenced to draw the attention of the student to the population variables presented visually in the data base. The sentences were designed to restrict the range of searching behavior on the part of the student.. The incomplete sentence forced the student to make a response. He was not provided alternate responses from which to choose, but had to construct his response using the data in the graphic. In the language of Silverman (1969), the stimuli were structured to increase their attention-provoking

properties and to reduce the possibility of confusion with other cues in the data base.

The responses that the students were to associate with these stimuli were selected from a visual data base which accompanied each set of stimuli. Because of the geographic and demographic character of the content in this unit, the data bases were presented in graphical form. Thus the student was presented with a written stimulus and was forced to differentiate the correct response from a data base composed solely of various types of graphics.

The feedback component of the S-R reinforcement model was presented in FIRM in the form of a student answer booklet. This booklet was designed to fit the self-instructional format of the unit. Students were instructed to refer to the answer booklet after matching each set of stimuli with their responses. When the responses that had been elicited by the student were correct, reinforcement in the form of knowledge of having made a correct response was provided. If an incorrect S-R association was made, reinforcement was withheld until the correct association was made.

FIRM, it therefore seems, may be interpreted as an alternate form of the S-R reinforcement model that has inherent similarities to, and yet differences from, the two most commonly used types of programs, the Skinnerian linear type and the branching or intrinsic type. Appendix B compares some of the characteristics of branching and linear

programming as outlined by Klaus (1965) and Lumsdaine (1960) with those of the FIRM alternative. However, the distinctions among the linear, branching, and FIRM reinforcement models are not so much ones of opposing methods as ones of different emphasis.

Background to S-R Theory

The experimental materials of this study consisted of FIRM and were compared with a narrative text supplemented with graphics. FIRM, in the judgment of the researcher, may be considered as an alternate application to curriculum of the S-R reinforcement model. Learning by reinforcement has been referred to by Skinner as operant learning or operant conditioning (1968).

Operant conditioning in its simplest form occurs when the learner that is responding is in a relatively free response situation. The learner generally has some deprivation--such as a lack of food. Under proper stimulus conditions, any response which is in the direction of the desired terminal response is followed by reinforcement and the deprivation is reduced. This increases the probability that the response will be elicited in the future under similar stimulus conditions. This process of repeating the stimulus successively rewarding more precise responses is referred to by Gagne (1970, p. 110) as "shaping." Thus, the learner is guided into making more desired terminal responses through a

series of rewards that follow succes... closer approxi-mations of the desired behavior (Va- , 1971).

In this study, the type of lea... at Skinner called operant conditioning will be referre... stimulus-response learning. This phrase was chosen be... this type of learning involves a single S-R connection ...because the S and R become bound together in a way that d... not happen in lower orders of learning (Gagne, 1970).

The S-R reinforcement model cons... of a particular form of behavioral analysis. It call... ttention to responses, reinforcements, and stimuli. In doing ... it indicates three essentials for learning: (1) the stim...us-control principle, (2) the activation principle, and (3) th... reinforcement principle (Silverman, 1969). The task ...erationalizing this model required the researcher to f... xamine the components of this model, and then to structure the materials so they included all of the basic principles inherent in the learning theory. In this application of S-R theory, the stimulus-control, activation, and reinforcement principles were operationalized in the following manner.

Stimulus-Control Principle

The FIRM format paid careful att... on to the construction of stimuli in a clear and unam...gu... manner. These stimuli assumed the operational form of incomplete declarative sentences whose structure and sequence were designed to facilitate easy stimulus discrimination by the student.

Activation Principle

The second essential for learning included in the S-R model is the activation principle. This principle involves a three-fold task of identifying desired responses, familiarizing students with responses not in their learning repertoire, and extinguishing incorrect responses that compete with the desired response.

The task of identifying the desired responses involved examining the stimulus stem and determining what word or phrase had been omitted. In most instances, the desired response was a proper name or a number that could easily be presented in a map or graph. All responses were presented in a visual data base that was located on the page opposite the stimuli which the data base accompanied.

The task of teaching technical terms not already in the student's learning repertoire was very important in the study because the content area of the population education unit was largely foreign to the students at this grade level. To facilitate this process, terms that were thought to be novel to the student were defined in the graphic accompanying the stem so that the proper response discrimination could then easily be made from the data base. For example, in introducing the phrase "population variable (Appendix H, p. 13)," the stem appeared as:

A population variable is a ... population that can change.

The response "trait" was presented in the key to the adjoining graphic, which also provided the full definition of population variable. This procedure was followed throughout the unit for providing definitions of terms thought to be unfamiliar.

The final step in the activation process was to determine which responses might compete with the desired responses and to reduce their probability of occurrence. Under the FIRM format, the structure of the data base was designed to facilitate inferential discriminations. When incorrect responses did occur, they were not strengthened by reinforcement, and thus were weakened and gradually extinguished.

Reinforcement Principle

The third major principle inherent in operationalizing the S-R reinforcement model was the reinforcement principle. This principle had two major aspects, the identification of a suitable type of reinforcer and the selecting of an appropriate schedule for providing reinforcement. The first aspect required a determination of those reinforcers which would effectively strengthen the responses to be learned. This reinforcement can result from external rewards such as praise, or being presented with a need-satisfying object such as food or candy, or the reward can satisfy an internal desire for achievement or a desire to satisfy curiosity about a particular subject. The FIRM strategy used internal rewards

in the form of providing the student with knowledge of his achievement as its mode of reinforcing desired behavior. This strategy was operationalized in the form of a student answer booklet which was used to check student responses.

The second part of the reinforcement principle involved the effective scheduling of reinforcement. Under the FIRM format, reinforcement was provided after the completion of each conceptual set rather than after each correct S-R pairing. This delayed schedule of providing reinforcement differentiates FIRM from the linear and branching types of programs.

Research in Programmed Instruction Directly Related to the Study

A review of the related research on the operationalized forms of S-R learning revealed that most of the studies pertained to the structure and use of programmed materials. Since most programmed instructional materials and the Forced Inferential Response Mode are based on S-R theory, the researcher examined some recent programmed learning studies, two of which directly related to this research.

One such study by Ryan (1967) examined four methods of organizing programmed materials: (1) programmed text and then readings on the same topic; (2) readings, then the programmed text; (3) a programmed text supplemented with selected map activities; and (4) the programmed text only.

The conclusion reached at the end of the research was that programmed materials supplemented with other media

increased criterion performance. Ryan's recommendations for integrating media and other techniques of instruction with programming are of interest because the Forced Inferential Response Mode uses the S-R reinforcement model which is the basis of most programmed materials, and incorporates it with a forced use of graphic media.

A study conducted by Wood (1964) compared classes using a combination of programmed materials and teacher-led instruction with classes using the common teacher-led method of teaching ninth grade geography. The findings from this study showed that students using the programmed instructional materials learned factual material significantly better than those using only the teacher-led technique. These findings were of particular interest because the unit, "Population Growth in the United States and Mexico," presents mainly factual content material. This research also showed no significant difference in the ability of students in the two groups to apply the material learned in the unit to new but similar situations.

Related Research on the Grade Placement and the Various Uses of Graphic Illustrations

In the application of the FIRM instructional strategy for the presentation of a population goegraphy unit, it was decided to construct a data base composed solely of graphics. This decision prompted a review of the literature related to grade placement and the effectiveness of visuals used in

social studies texts. This review was expanded to include studies that compared the relative effectiveness of graphics used in differing roles. These studies were included because the characteristics of the two instructional formats compared in this study used graphical media to serve differing functions.

Grade Placement

Studies pertaining to the use of graphical materials with primary and intermediate grade students were surveyed to determine if students in these grades were sufficiently mature to use graphics in learning social studies concepts. From the following review of these studies, the use of graphics in a unit designed for grades 5, 6, and 7 was therefore deemed appropriate.

Thomas (1933) conducted an experiment to determine if students in the upper elementary grades could derive information from various types of graphics. He selected his samples from middle grade populations and placed students in categories of slow, average, or superior for each grade level. The results of this experiment showed that students ranked as low as a grade four superior could read simple facts and understand the meaning of graphs.

Thomas' conclusion that middle grade students could derive information from various types of graphics was supported by a study conducted by McAulay in 1964. The purpose of

McAulay's research was to determine if fourth grade students were sufficiently mature to learn map reading skills and utilize them in the learning of social studies concepts. The results of this study indicated that the treatment groups that used maps of Pennsylvania in their study of the state scored significantly higher than those that relied solely upon books and pictures. This research indicates that graphics can be employed as learning tools by students as low as grade 4.

This is not to say that the fourth grade is the lowest level at which graphics can be effectively used. To the contrary, research by Savage and Bacon (1969) indicated that graphic skills can be taught in the primary grades.

Uses of Graphic Illustrations.

The question of how graphic illustrations are used and how they can be used more effectively to teach social studies content was basic to this study. Davis (1968, [b]) outlined three roles that graphic illustrations play in social studies texts today:

1. In a very few instances they are used as a primary source of content materials or the principal means of message communication.

2. More often, graphic illustrations are used to abstract or reinforce ideas already presented in written narrative form. In this role they provide a visualization of concepts and ideas already presented in a written form.

3. Maps, charts, and graphs are not directly related to the transmission of content material; but rather they are used to provide flavor and add atmosphere to the text.

Examples of graphics used in the third manner are quite common in elementary geography textbooks. In these books, maps are included as a part of the text. The student is not instructed to use them as a primary data source, nor is the map expressly used to reinforce or abstract data presented in the written body of the text.

It is essential that a developer of curriculum materials recognize the various roles that graphics play so that the success or failure of the graphics used in materials can be assessed. It is also important that a curriculum developer have an understanding of which role is most suitable to meet the needs of the population that the materials will serve. He can then design his graphics to fit the role that will meet his instructional objectives.

In the literature on the use of graphics, most studies have dealt with graphics in only one of the three roles outlined by Davis. One researcher that did make an inter-role comparison was M. D. Vernon (1952). In a study using English Air Force cadets, she compared treatment groups using only graphic materials with groups using a continuously written text illustrated graphically. The content material involved the demographic characteristics of the English population during World War II. The results of this experiment indicated

that only comparatively intelligent and well-educated cadets could derive information from graphics presented without written material.

Other studies have investigated the effectiveness of graphics as the principal source of content, or as abstractors, reinforcers, or visualizers. The studies that related to graphics in their first role (principal source of content) were primarily concerned with the ability of students to derive information from various types of graphs and charts. Such studies commonly compared the effectiveness of two or more forms of graphics for presenting similar content material.

Wrightstone (1926) used junior and senior high school students to compare the value of conventional graphs with pictorial graphs in presenting data. This experiment tested the student's ability to interpret data directly from the graphs as well as the student's ability to recall the data. His findings showed that groups using the pictorial graphs were able to locate facts in the graphs at a significantly higher rate, but the difference in the level of recall between the groups was not significant.

Washburne (1927) utilized junior high school students to compare various graphic, tabular, and textual methods of presenting quantitative material. He concluded the arrangment of such material was much more vital to recall than the quantity of material presented.

Croxton and Stryker (1929) compared the use of bar charts and circle diagrams. They concluded that when graphs express only two proportions, the pie graph is read more accurately if the proportions are 50-50 or 25-75. There is little difference, however, in which form is used if the figures express other proportions.

In a similar study, Croxton (1932) compared the effects of bars, squares, circles, and cubes with larger and smaller sums. He concluded that there was no difference in accuracy in interpreting circles and squares, but he found both to be superior to cubes.

In a more inclusive study of the ability of individuals to interpret data from various graphic forms, Peterson and Schramn (1954) used 86 subjects at Sampson Air Force Base to assess the accuracy with which the subjects interpreted data from eight types of graphs (circle, disc, single bar, multiple bar, multiple cylinder, multiple square column, multiple area column, and partial cosmograph). The results of this study indicated that the form of graphics used significantly affected the accuracy with which they were interpreted. When showing the parts of a whole, the circle and the multiple area column graph were read least accurately.

Research on the value of using graphics in their second role (reinforcer or visualizer) has been conducted by a number of researchers. In the second part of the previously mentioned study by Vernon, samples were selected from sixth

grade students to determine if graphics assisted in clarifying material and led to a better understanding of the general argument in the written text. Vernon concluded that the written argument was not made easier to understand and retention was not improved by using graphs with the written text.

In a later study, Vernon (1956) tried to assess the value of pictures to illustrate verbal text. The results from this research indicated that pictures might stimulate some people to read an article, but there was no indication that they helped to promote understanding.

Another researcher who explored the effectivness of using graphic illustrations with written text materials to promote learning of social studies concepts was O. L. Davis (1968, [a]). In a very broad study, Davis compared the performance of two groups of junior high school students. The first group was given three narratives illustrated with time lines, distribution maps, and bar graphs. The second treatment group received the same three narratives but they were not given the graphics. The reported results indicated that the use of the time line and distribution maps did not affect performance on a criterion test. The bar graph, when presented with the narrative, did facilitate learning. A third finding of the Davis study had direct bearing on this experiment--analysis of covariance was found to be more precise than analysis of variance in assessing group performance

because the analysis of covariance would adjust the criterion scores for relevant covariants. Davis used IQ scores and reading achievement scores as covariants.

Earlier experiments conducted by Davis and Hicks that related tangentially to the value of using graphics in their second role (reinforcer) were conducted in the spring of 1966. Davis and Hicks evaluated the use of a time line for promoting pupil learning of chronological relationships. The performance of three groups of senior high school students was compared. Treatment 1 had a narrative plus a correctly drawn time line. Treatment 2 had the same narrative with an incorrectly drawn time line. Treatment 3 had only the written narrative. There was no significant difference between Treatments 1 and 2. Both Treatments 1 and 2 were more effective than Treatment 3. Davis generalized from this study that some illustration of chronological relationship, no matter whether it was correct or not, was superior to the narrative used alone.

Davis' conclusion that graphics used as reinforcers and visualizers promoted learning was not supported by similar research in other content areas. Burdick (1959) tried to evaluate the use of various types of graphics to improve the comprehension of written secondary level science materials. This study compared two treatment groups. The first used a written passage supplemented with a cross-sectional drawing, and the second used a perspective-cutaway

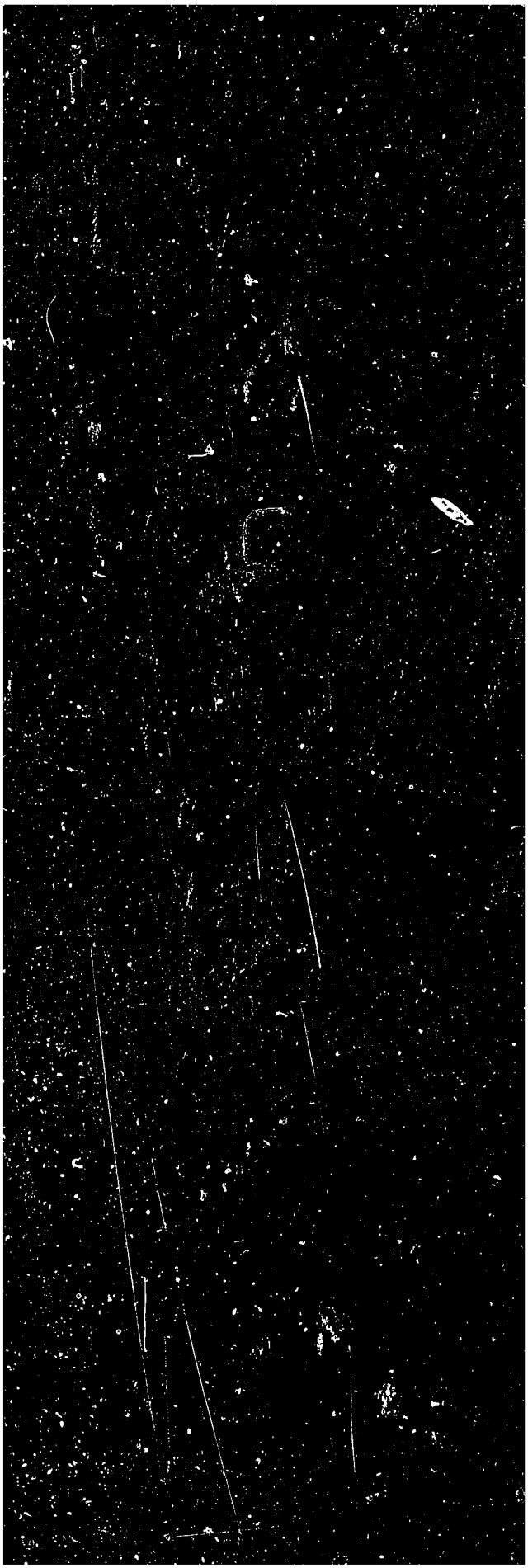
drawing. The third treatment group used only a written passage. The results showed no measurable difference in comprehension of the written passage among the three treatment groups.

This review of the effectiveness of graphics in instruction is equivocal. It shows that a variety of graphic forms, as employed in the population unit, have been previously utilized in graphic research.

Summary

This review of the related literature provided a background for S-R theory and cited several studies that used this theory in the operationalized form of programmed instruction to teach factual social studies content. The value of using graphic media with this model was also explored. No research directly related to the FIRM operationalized form of the model was reviewed because this is a new and previously untested form of the S-R reinforcement model. This study provides an evaluation of the effectiveness of this learning strategy for the presentation of a social studies unit to middle grade students.

Since the unit tested in this research was graphically oriented, the suitability of using graphic media with intermediate grade students was substantiated by several studies. The various roles which graphics can assume in social studies texts was also explored. The conclusions derived from this survey indicated that most of the research into the uses of



graphics was limited in scope to examining graphics used in only one of the three roles outlined by Davis. The only study surveyed that compared the use of graphics on an inter-role basis indicated that graphical illustrations used as primary conveyors of content material were of value to only intelligent and well-educated people.

This study makes a contribution to graphics research by comparing the performance of treatment groups that used graphics as primary and supplementary sources of information. FIRM used graphics as a visual data base; the alternate treatment used graphics to reinforce the information presented narratively.

CHAPTER III

DEVELOPMENT OF MATERIALS USED IN THE STUDY

This chapter presents the rationale for the selection of population geography as the content area for the middle grade social studies unit which was developed as a part of this study. In addition, it describes the objectives on which the unit was based and the structure and sequence of the content presented in the unit, "Population Growth in the United States and Mexico." The final portion of this chapter describes the components of the instructional unit which include treatment books, answer booklets, glossary of unfamiliar words used in the materials, pronunciation tapes, standardized tests, and criterion posttests.

Materials Development

Prior to the actual research, the development of a unit of materials entitled "Population Growth in the United States and Mexico" was undertaken. This unit was to serve as the vehicle for testing the FIRM instructional strategy against a written narrative that used graphics as reinforcers and visualizers.

Content Rationale

The need to improve population education in American education was noted by Hauser as early as 1962. He noted that "The facts and implications of population change are indeed conspicuous by their absence or by their superficial and cursory treatment in American education (p. 424)." A decade after this observation by Hauser, Viederman indicated in a report on the status of population education in the United States that a deficiency in population content material still exists and that the population education program in American schools is still inadequate (Viederman, 1972).

This researcher assumed the task of trying to reduce this deficiency by developing a unit on population geography appropriate for use by students in the middle grades. This unit utilized a comparative approach in analyzing population growth in the United States and Mexico. These two countries were selected because they are commonly studied as a part of the middle grade social studies curriculum. An additional consideration in the selection of Mexico and the United States was that these countries are both New World nations that came under European influence in the 16th and 17th Centuries. These nations were also chosen because of differences in the indigenous groups and the ways in which Spanish and English cultural heritages have contributed to profound differences in the social and economic conditions in these nations today. These differences have so affected population dynamics in

Mexico and the United States over the past 300 years that they offer two countries of sharp population contrast today.

Structure of the Unit

A review of population materials currently available for use with elementary and middle grade students showed that many of the units had objectives of an affective rather than a cognitive nature. (See Appendix A for a state-by-state review of materials.) Titles such as "Science and Survival," "Disaster," and "Resource Limits on Population Pressure" indicate that the developers of such materials view the present world's demographic situation as a grave problem.

In contrast, "Population Growth in the United States and Mexico," with other conceptual units of the Geography Curriculum Project, emphasizes cognitive objectives. These units attempt to follow the suggestion of Viederman (1971) that population should be viewed as a phenomenon to be understood and not as a problem to be solved. It is the purpose of the Geography Curriculum Project materials to inform students, not to indoctrinate them.

To meet this objective of presenting population as a phenomenon to be understood, the unit describes population changes in the United States and Mexico. The unit points out some of the factors that were instrumental in causing changes in each nation's population, but does not try to evaluate whether these factors had a positive or negative effect on the living conditions in each country. In Part 3,

some projected estimates are made, derived from the United States Census Bureau and the Population Reference Bureau. These figures represented median rather than extreme estimates.

To develop a cognitively structured unit on the population changes in Mexico and the United States, a conceptual outline was developed, mainly following the topics that Hauser (1962) listed to be essential elements of a population course. Other population authorities consulted included Trewartha (1969), Peterson (1961), and Zelinsky (1966). The specific authentics by part and lesson set are listed in Appendix J.

FIGURE 1

CONCEPTUAL SCHEME FOR THE DEVELOPMENT OF A POPULATION UNIT

I. TOTAL POPULATIONS

- A. Pre-Columbian Population of Each Region
- B. Population Changes in These Regions Since 1500
- C. Number of Inhabitants in Each Region as of the Last Census
- D. Future Growth Projections Based on Median Estimates

II. COMPONENTS OF POPULATION GROWTH

- A. Mortality
- B. Fertility
- C. Migration
- D. Theory of Demographic Transfer

III. POPULATION DISTRIBUTION

- A. National
- B. Regional
- C. Rural and Urban

IV. POPULATION COMPOSITION

A. Age Structure
B. Sex Ratios
C. Ethnic Groups
D. Economic Characteristics

V. METHODS OF POPULATION RESEARCH

A. Census Characteristics
B. Population Pyramids
C. Construction of Birth Rates, Death Rates, and Migration Rates

This structure was placed in a regional framework and the population changes in the United States and Mexico were analyzed. The factors that caused these changes were pointed out through the presentation of statistical information in the data base to illustrate the magnitude of the changes.

Preparation of Materials

The materials prepared for use in the study consisted of two treatment forms, FIRM and a narrative text; an investigator-constructed posttest; a glossary of words; a pronunciation tape; and introduction and instruction sheets for the teachers and students.

Content in both treatments was presented in a chronological manner. The six topics that received particular emphasis were (1) the causes of the decline of the aboriginal populations; (2) factors that affected birth rates, death rates, and migration rates; (3) the degree of racial mixing that had occurred; (4) the history and rationale for conducting population censuses; (5) the current distributional

patterns of each nation's population; and (6) the geographic and demographic trends in each nation today.

The content materials for the unit were assembled during the researcher's two years at the University of Georgia. During this time, course work in population geography, Caribbean-American geography, and urban geography contributed to the researcher's background for writing such materials. The actual materials writing involved three months of research, writing, and revising. The reference sources utilized were the latest and most authoritative available at the University of Georgia library.

The unit that resulted from this research was a comparative study which contrasted the demographic history of Mexico with the demographic history of the United States. The unit was written in two different forms for experimental evaluation. The first form (T_1) was prepared for use by the experimental group in the study. The content material in this treatment was organized according to the structure of the Forced Inferential Response Mode (FIRM). The treatment consisted of 3 parts and 41 sets of topically-organized stems which took the form of incomplete sentences. To complete the meaning of the stems, information had to be inferred from the data base. When the stems in a set were correctly completed, the stems constitutued a logical narrative describing a particular facet of population growth in Mexico or the United States.

The data needed to complete these stems was presented in 54 figures located on the pages opposite the stems with which the figures were associated. These figures were professionally drafted and contained a variety of maps, charts, graphs, and tables. In addition to figures and stems, the 96-page FIRM book contained a detailed explanation of the use of the various graphics as well as FIRM practice exercises.

The book was divided into three parts. Part 1 analyzed changes in the Mexican population since 1500. Part 2 contained a similar analysis of demographic changes in the United States since 1500. Part 3 compared the demographic and geographic character of each nation's population in the year 2000. A set of 15 review questions followed each of the three parts. These questions were designed to facilitate a review of the content in each part and to help prepare students for the final test which covered all the materials presented in the unit.

A glossary of all terms that were thought to be unfamiliar to the students was included at the end of the unit. Many of the words defined in the glossary were Indian or Spanish names or specific terms commonly used in geographic or demographic literature. To supplement the glossary, the researcher developed a word tape for use in each classroom. This tape presented pronunciation of the words listed in the glossary.

Treatment 2 was a narrative text. It contained the same content material and the same 54 figures as the Treatment 1 unit. The essays in the Treatment 2 materials were written by filling in the stems in the FIRM treatment and arranging these sentences into logical paragraph form.

Every effort was made to make the content presentation in each treatment identical. Both treatment groups had the same review questions, glossaries, and word tapes. The only differences were the color of the book covers (yellow or blue), the different format of the sets (stems or narrative), and the directions the students were to read for using their materials.

Since both of these treatments were designed for use on a self-instructional basis, it was essential to develop a scheme for reinforcing correct responses and extinguishing incorrect responses. To help fulfill this need, a 47-page answer booklet was developed to be used with both treatment groups. This booklet contained the information needed to complete the stems in Treatment 1 and the answers to the review questions. Although the Treatment 2 group did not need the answers to the stems, they did need to utilize the answers for the review questions. The answer booklet also helped Treatment 2 students to identify major ideas in the narrative.

The FIRM-instructed student was directed to use the answer booklet to correct his work. If the student made an

incorrect response, he was directed to strike out the response and to reexamine the data base to determine the correct response. The correct answer was to be placed directly above the crossed-out answer and then checked again with the answer booklet.

Tests Used in the Study

The development of materials for the study included the selection of standardized tests to be used to measure student skills and performance and the construction of a criterion posttest.

Standardized Tests

Three sections of the Iowa Tests of Basic Skills, Form 5, Level 12 were used as the pretest: (1) Test V, Vocabulary; (2) W1, Map Reading; and (3) W2, Reading Graphs and Charts. The same level and form of Tests W1 and W2 were also used as a part of the posttest evaluation procedures.

Criterion Test

A 50-item, 4-option, multiple-choice test of unit content was used as part of the posttest evaluation procedures (Appendix D). This test was a modified form of the instrument used with the pilot groups (Appendix E). The content validity of the instrument was maintained by developing the questions directly from the instructional objectives of the unit (Appendix C) and by having the director of the Geography

Curriculum Project compare the test items with the content objectives.

The reliability of the criterion test was first computed by the TSSA (Test Scorer Statistical Analysis) program for the pilot test (Wolf and Klopfer, 1963). From this program a three-step approach for using the item analysis was employed to improve the reliability of the posttest used in the field trials. A further discussion of the procedures used to insure the validity and reliability of the criterion posttest is presented in Chapter IV.

CHAPTER IV

PROCEDURES AND METHODOLOGIES

Chapter four describes the design used in conducting the experiment, the assumptions inherent in the design, and the limitations of the research. The last part of this chapter outlines the procedures followed in conducting the study.

Research Design

The research design selected for use in the experiment was the pretest, posttest control group design. The rationale for this selection was based on two principal factors. First, the nature of this design gives two measures of individual performance. The first measure, the pretest, is of special value when dealing with two or more groups that receive alternate treatments. This measure provides the experimenter with the opportunity to control statistically on otherwise uncontrolled variables that are highly correlated with criterion test performance. In the study, reading ability and skill in reading maps, graphs, and tables were considered to be experimentally uncontrollable variables, or covariates, that were highly correlated with criterion test performance. These covariates were measured in the pretest phase of the study by using portions of the Iowa Tests of

Basic Skills. The covariates were measured so that the experimenter could conduct a valid evaluation of the results of the experiment.

A second consideration in selecting this design was that when the design is properly carried out, it effectively controls for the eight threats to the internal validity of a study outlined by Campbell and Stanley (1963).

Treatment Groups

The total sample for the experiment consisted of 15 intact classrooms, 3 of which were used in the pilot phase, and 12 in the field trials. These classrooms were equally divided into five groups from each of the fifth, sixth, and seventh grades. The students in each of these grades were randomly assigned to either Treatment 1 or Treatment 2.

In Treatment 1 (T_1), students used the self-instructional unit, "Population Growth in the United States and Mexico," organized according to FIRM (Forced Inferential Response Mode).

In Treatment 2 (T_2), students used the self-instructional unit, "Population Growth in the United States and Mexico," organized in a written narrative supplemented with graphics.

Teacher Participation

Eight middle grade teachers from Clarke and Oconee Counties, Georgia, participated in the study. All were women and experienced teachers. The teachers' participation

in the experiment was on a voluntary basis. There was no remuneration for their efforts. The role of the teacher in the study was limited to giving preliminary instructions, distributing materials to students, and scheduling evaluations. Although the teachers were present in the classrooms, their interaction with the students was kept to a minimum due to the self-instructional nature of the units. The researcher visited all classrooms on numerous occasions to explain the purposes of the experiment and to insure that procedures were being properly followed.

Assumptions of the Study

The following assumptions were basic to the study:

1. The nature of these materials was so new and unique for use at this grade level that a pre-test of content would have been of no value.

2. Outside variables were controlled for by the random assignment of subjects to treatment groups.

3. The Iowa Tests of Basic Skills provided an accurate measure of pre-experiment skills in reading, map, and graphic skills.

4. The standardized tests and the test developed for the study were valid measures of the desired learning outcomes.

5. The teachers followed the directions given them and made every attempt to minimize teacher-student and student-student interaction.

6. The use of the analysis of covariance provided a method of adjusting for correlated uncontrolled variables so that a valid analysis of experiment results could be made.

Limitations

The study was carried out with these limitations to internal validity:

1. The use of the Iowa Tests of Basic Skills, Form 5, Level 12, Tests W1 and W2 in both the pretest and posttest parts of the study led to the danger that part of the differences in the pre- and posttest performance could have been due to students becoming "test wise." Alternate forms of these tests were available; however, their inclusion in the total ITBS (Iowa Tests of Basic Skills) battery for grades 3 through 8 made their cost prohibitive for use in the experiment.

2. Perhaps the major limitation of the study was the researcher's inability to control for the time variable. This was the result of the various rates at which the students worked through the units and the numerous interruptions that occurred in the class periods in the various schools. Interruptions such as field trips, assemblies, special speakers, fire drills, and previously scheduled school testing programs all made an accurate assessment of the time spent in learning by each student an impossible task for an experiment including as many subjects as were involved in this study. The researcher noted the advice of English (1971): "Early research most always concentrates all of its efforts in order to demonstrate that a phenomenon can be produced and subsequent research must examine more closely the factors that produced the phenomeonon (p. 3)."

3. Although the materials were self-contained and teacher participation was carefully circumscribed, the study climates of the separate classrooms and schools may have affected learning differentially.

4. The attempt to operationalize FIRM as an alternate form of the S-R reinforcement model was not independently replicated. The FIRM format conforms to the S-R

reinforcement model in the opinion of the researcher, but the study provides no empirical evidence to confirm or reject this assumption.

Description of the Sample

The sample used in the experiment consisted of fifth, sixth, and seventh grade students from Clarke and Oconee Counties, Georgia. A total of 15 classes participated, of which 14 were drawn from schools in Clarke County. The only class included from Oconee County was a seventh grade class which took part in the pilot phase of the study.

Clarke County is Georgia's smallest county and is located in the northeastern part of the state. The county is largely dominated by the city of Athens, which is the site of the University of Georgia. In 1970, the city of Athens accounted for more than half of the county's total population of 65,177.

As shown in Figure 2 (p. 46), the county's population is predominantly urban in character, with less than 2% of the residents living in households where the chief source of income was derived from farming.

FIGURE 2

URBAN AND RURAL POPULATION OF CLARKE COUNTY: 1960-1980

Locality	Population		Projection	
	1960	1965	1975	1980
Urban and non-farm	44,230	52,000	67,200	74,500
Rural farm	1,333	1,000	800	500
Total	45,363	53,000	68,000	75,000

The racial composition of Clarke County's population in 1970 showed Whites to outnumber non-Whites by a ratio of nearly 4:1. The county school population showed a ratio of Whites outnumbering non-Whites by 2:1. Since the 1960 census, both the White and non-White segments of the population have increased markedly in their total numbers. Figure 3 illustrates the racial composition of the county.

FIGURE 3

RACIAL COMPOSITION OF CLARKE COUNTY'S POPULATION: 1940-1970

Year	Whites	Non-Whites
1940	18,335	10,063
1950	26,614	9,936
1960	33,748	11,615
1970	52,037	13,140

The rate of population growth for Clarke County during the last ten-year period was 43.7%. This rate ranked Clarke County as one of the ten fastest growing counties in Georgia.

Economic conditions in the county, as reflected by the average income per household, showed Clarke County to be above the state average of $9,355 per year. The county's average of $10,263 was slightly below the national average of $10,565 per household, per year.

A similar pattern of Clarke County's approximation to national norms is reflected in the statistics available on pupil test performance as measured by the county testing program. Results from the Iowa Tests of Basic Skills administered to all fourth and eighth graders in the fall of 1971 showed that pupil performance in the vocabulary portion of this test, as well as the map and graph sections, was closer to the national norms than the state norms. Figure 4 (p. 48) demonstrates the performance comparison for the Iowa Tests of Basic Skills for grade 4.

FIGURE 4

COMPARISON OF CLARKE COUNTY AND GEORGIA 1971 RESULTS

WITH NATIONAL NORMS

IOWA TESTS OF BASIC SKILLS, GRADE 4

Group \ Test	Vocabulary	Reading	Map Reading	Graph Reading	Composite
National	41.1	42.3	41.9	41.8	41.8
Georgia	36.4	37.6	37.7	38.1	37.7
Clarke County	39.1	40.6	41.1	40.8	40.3

Figure 5 demonstrates the performance comparison for the Iowa Tests of Basic Skills for grade 8.

FIGURE 5

COMPARISON OF CLARKE COUNTY AND GEORGIA 1971 RESULTS

WITH NATIONAL NORMS

IOWA TESTS OF BASIC SKILLS, GRADE 8

Graph \ Test	Vocabulary	Reading	Map Reading	Graph Reading	Composite
National	80.5	81.5	82.0	81.3	81.5
Georgia	70.7	72.8	71.7	71.8	72.0
Clarke County	77.7	78.7	80.2	77.4	77.6

This pattern was also evident in the composite score for the total ITBS battery of tests. Clarke County students scored above the state norms and only slightly below the national norms.

This brief glance at Clarke County, Georgia, showed it to be a rapidly growing area that is urban in character. Its population is largely dominated by the city of Athens, and is strongly influenced by the presence of the University in the city. Income levels in the county are much closer to the national average than the state average, and data available on pupil performance reflects this same trend. These factors indicate that in many ways the sample used in this study more closely resembled national norms rather than state norms.

Sample Selection

The sample selected for use in the field trial of the experiment consisted of 12 intact classrooms from the Clarke County schools. Of these 12 classes, 4 each were from the fifth, sixth, and seventh grades. Figure 6 (p. 50) shows the distribution of the sample population.

FIGURE 6

DISTRIBUTION OF SAMPLE POPULATION

School	Grade	Number of Classes	Number of Pupils
Barnett Shoals Road Elementary	5	4	92
East Athens Elementary	6	4	106
Pattie Hilsman Junior High	7	4	113

The random assignment of students to treatment groups was made at grade level rather than from the total pool of students used in the experiment. This procedure was necessitated because the teachers who agreed to allow their students to participate in the experiment were unable to make their classes available at the same time. The four fifth grade classes at Barnett Shoals Road Elementary School started on May 5. The four sixth grade classes at East Athens Elementary School started on May 8, and the four seventh grade groups at Pattie Hilsman Junior High School began on May 22.

The procedures followed in assigning students to treatment groups were those outlined by Walker and Lev (1953) for use in choosing a sample from a three digit number. This process involved the use of the "Table of 105,000 Random Decimal Digits" published by the Interstate Commerce Commission.

All students were assigned a number according to their alphabetical placement in their class and grade level. This number, selected according to the random selection process, was used to place the students in Treatment 1 or Treatment 2.

To prevent confusion and to facilitate the distribution of materials by the teachers, student names and numbers were typed on labels and placed on the cover of each book prior to their distribution.

The only students not included in the randomizing process were those with reading scores below the fourth grade level. The information regarding these students' reading level was obtained through teacher conferences. The rationale for their exclusion was that students reading at levels below the fourth grade level would have great difficulty with Treatment 2, the written narrative. It was decided by the researcher, after consultation with the teachers, to arbitrarily give those students the FIRM treatment (Treatment 1) because of its more structured nature. It was felt that it would be of more value to these students. The scores obtained from these students' performance on the criterion posttest were not included in the final analysis of the data.

Test Selection, Construction, and Validation

The material tested in the experiment placed great emphasis on the student's ability to read and his ability to use maps, charts, and graphs, It was therefore necessary

to measure pre-experiment skills of these predictor variables. All students were given three parts of the Form 5, Level 12, Iowa Tests of Basic Skills to assess student skill in these areas prior to the start of the treatments. The parts of the total battery of tests selected for use in the experiment were Test V, a 17-minute vocabulary test; Test W1, a 30-minute map reading test; and Test W2, a 20-minute test of skill in reading graphs and tables.

These tests were selected primarily because of the high reliability of the individual tests: Test V, Vocabulary--.88; Test W1, Map Reading--.71; and Test W2, Reading Graphs and Tables--.71. A second reason for their selection was that the ITBS constitutes part of the Georgia State Testing Program. Thus the use of the tests would most likely be familiar to the teachers and administrators in the schools where the samples were drawn.

The three parts of the ITBS constituted the pretest phase of the experiment, and parts W1 and W2 were also used as a part of the post-experiment evaluation. The purpose for the readministration of these parts of the ITBS was to evaluate changes that had occurred in student skill in using maps and graphs during the experiment.

Content Validity

The second part of the post-experiment evaluation consisted of a 50-item, 4-option, multiple-choice test of unit content. The content validity for this instrument was

assumed to be high based on the test construction procedures followed by the researcher.

The initial step in preparing this test was to construct a list of 6 general and 71 specific instructional objectives (Appendix C). From this list of objectives, 120 four-option multiple-choice questions were constructed. From this pool, 59 questions were selected for use in the pilot form of the criterion posttest. The questions chosen were selected on the basis of their contextual and behavioral characteristics.

After the results from the pilot program were reviewed and analyzed, the number of questions to be used in the field testing form of the criterion posttest was reduced to 50 based on the difficulty and discrimination power of each item. To assure that the content validity of this shortened form of the test had not been adversely affected, a table of specifications (Appendix F) was constructed to compare the content dimension and behavioral dimension of the pilot and field testing forms of the criterion posttest. To further check the content validity, the remaining questions were submitted to the director of the Geography Curriculum Project for review. He audited the test items in terms of graphic and sentence content, unit objectives, and table of specifications. His recommendation that the criterion posttest include more graphic-type items was rejected by the researcher because the inclusion of more graphical questions would have significantly altered the behavioral and content dimension

of the posttest. Moreover, the testing of graphical learning was covered by Tests W1 and W2 of the Iowa Tests of Basic Skills.

Test Reliability

The procedures followed for determining the reliability of the posttest instrument first involved administering the 59-item form of the criterion posttest to the students in the pilot groups. The results from this test were analyzed by the TSSA (Test Scorer and Statistical Analysis) computer program. This program reported various test statistics and item analysis information. One statistic, the reliability coefficient of the test, was considered to be of special importance because of its value as an indicator of test quality. Ebel (1965) indicates that: "For most tests of educational achievement, the reliability coefficient provides the most revealing statistical index of quality that is ordinarily available (p. 308)." The reliability coefficient and the standard error of measurement of the pilot form of the criterion posttest are presented in Figure 7 (p. 55).

FIGURE 7

TEST ANALYSIS DATA FOR PILOT FORM OF CRITERION POSTTEST

Grade	Number of Students	Number of Questions	Estimate of Reliability KR20 Method	Standard Error of Measurement
5, 6, 7	85	59	.87	3.4

The TSSA computer program also provided item analysis data that was used to shorten the pilot form of the criterion posttest. From the information provided by this program, the difficulty level of each test item was determined by reviewing the percentage of students that responded correctly to each item. From this data a difficulty index was constructed (Appendix G) which provided a basis for dropping test items that were shown to be too easy or too difficult.

A second procedure followed in revising the pilot form of the criterion posttest involved the determination of the discriminating power of each test item. This index was developed by comparing the number of high-scoring individuals who responded correctly with the number of low-scoring individuals who also responded correctly. This comparison was based on the test score performance. The high-scoring group was composed of the upper third of the class and the low-scoring group was composed of the lower third of the group. This method of dividing the class was used to

prevent overlapping due to the error of measurement in the test. This procedure, along with the index of item difficulty, allowed the investigator to drop ten items from the pilot form of the posttest. Not all of the items that ranked low according to the item analysis procedures could be omitted because of the risk of adversely affecting the validity of the test. This necessitated a third level of item analysis.

The third item analysis procedure was employed to improve those questions that ranked low according to the indices of item difficulty and discrimination. Since the criterion posttest was a multiple-choice instrument that had four alternative answers for each question, the discriminating power of each distractor in these questions was computed according to the "Findley D" procedures (Findley, 1956). This technique provided a way for the researcher to improve the test reliability by changing some of the distractors that ranked low in their discriminating power, rather than dropping questions that were vital in maintaining test validity.

The revised and shortened version of the posttest was used in the field trials. The results were analyzed and the reliability of the test was estimated using the Kuder-Richardson formula #21 and the Saupe R_{20}, formula (Payne, 1968). The results of this analysis are shown in Figure 8 (p. 57).

FIGURE 8

TEST ANALYSIS DATA FOR

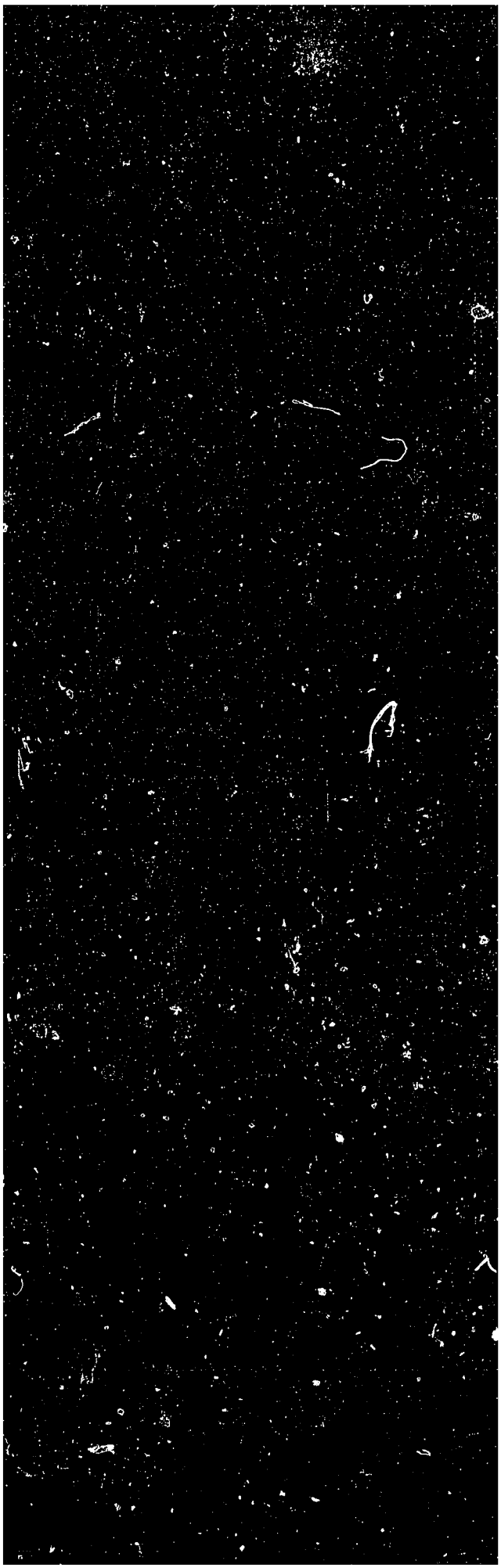
FIELD TEST FORM OF CRITERION POSTTEST

Grade	Number of Students	Number of Questions	Estimate of Reliability KR 21 Method	Estimate of Reliability R_{20}, Method	Standard Error of Measurement
5	92	50	.91	.94	3.2
6	106	50	.90	.92	3.2
7	113	50	.91	.93	3.2
Total	311	50	.91	.93	3.2

Procedures of Pilot Test Phase

The reason for conducting a pilot study was to test the procedures, materials, and evaluation instruments that were to be used in the field testing phase of the experiment. Three classrooms were used for this part of the experiment; two were located in Clarke County schools and one was located in an Oconee County School.

The pretesting portion of the pilot program involved the administration of the Iowa Tests of Basic Skills, Form 5, Level 10, Tests W1, Map Reading, and W2, Reading Graphs and Tables, to all classes. The ITBS, Test V (Vocabulary) was also given. The fifth grade class received Level 11, the sixth grade received Level 12, and the seventh grade received



Level 13. Level 10 of Tests W1 and W2 was used with all grades because of the availability of the tests and knowledge that these tests have a level of difficulty higher than their recommended grade levels.

The results from these tests showed they were suitable for use with all of the fifth grade and most of the sixth and seventh grades. But some of the sixth and seventh grade students did so well on the pretest that it was felt that there was a risk of not being able to accurately measure improvement on the posttest. In an attempt to eliminate this risk, the Form 5, Level 12 of the ITBS was purchased for use in all of the field test groups.

A second change which resulted from the pilot study was the elimination of the detailed time schedule followed by the pilot teachers. The pilot program showed that the fifth grade students would need more time to complete the Treatment 1 books than was originally allotted. The time differential between the two treatments varied from student to student, but it appeared that the Treatment 1 group took approximately 1/3 more time than the Treatment 2 group to complete the unit materials. This led to the use of a very flexible time schedule to assure all students sufficient time to complete their material in the field testing program.

The cost of printing the treatment books precluded revision of materials as a result of the pilot trial. Errors detected in the pilot trial were called to the attention of

students prior to the beginning of the field trial. These errors were minor in nature--a few misspellings and the omission of one answer from the answer booklet.

Another necessary revision that the pilot trial emphasized was the need for a truly randomized treatment assignment. In the pilot trial, teachers were instructed to randomly assign books, but results on the prestest showed the treatment groups not comparable. This problem was alleviated in the field testing by using a table of random numbers to assign students to their groups. This procedure took the responsibility for sample assignment from the teacher and placed it in the hands of the researcher.

The final modification that resulted from the pilot phase of the experiment was test improvement, as previously described (p. 51).

Procedures of Field Test Phase

From the information gathered in the pilot phase of this experiment, the instruments and procedures were modified for the field testing which began May 8, 1972. The sample selected for use in the field test was composed of 311 middle grade students selected from three schools in Clarke County, Georgia. These students were randomly assigned to treatment groups and were allowed to work through the materials at their own pace.

All students in the study received the Form 5, Level 12, Tests V, W1, and W2 parts of the Iowa Tests of Basic Skills as a pretest, and Tests W1 and W2 as a segment of the post-treatment evaluation procedures. In addition to these tests of skills, a 50-item, researcher-constructed criterion post-test was also administered to all students. The field testing was concluded on May 26, when the last seventh grade classes completed their posttests. Following the completion of the field testing, all tests were collected and hand scored by the researcher. The results from these tests were then sent to the University of Georgia Computer Center for analysis, the results of which are presented in the following chapter.

CHAPTER V

FINDINGS AND DISCUSSION OF THE FINDINGS

The first part of this chapter presents a summary of the raw scores for all pre- and posttests that were administered. The results of these tests are reported by treatment group and grade level and the statistical procedures used to analyze these scores is also outlined. This is followed by the presentation of the findings in relation to the hypotheses stated in Chapter I. The last part of the chapter reviews the statistical findings and relates them to the theoretical framework upon which this study was based.

Background to the Findings

The statistical data that was collected for this study was obtained from the administration of the six tests identified in Figure 9 (p. 62). The results from these tests were analyzed by treatment (Figure 9) and grade level (Figure 10, p. 62) using the MUGALS (Modified University of Georgia Analysis of Least-Squares) computer program. This program provided a univariate analysis of multiple covariance and a Duncan Multiple Range Test so that comparisons among treatment and grade level means could be made.

FIGURE 9

RAW SCORE SUMMARY BY TREATMENT GROUPS

Test	Treatment 1 Mean Score (154 Subjects)	Treatment 2 Mean Score (157 Subjects)
Vocabulary Pretest	27.17	27.74
Map Pretest	20.21	19.85
Map Posttest	23.31	23.08
Graph Pretest	12.69	12.96
Graph Posttest	14.56	14.34
Criterion Posttest	27.62	28.00

FIGURE 10

RAW SCORE SUMMARY BY GRADE AND TREATMENT GROUPS

Test / Number of Subjects	Grade 5		Grade 6		Grade 7	
	T_1	T_2	T_1	T_2	T_1	T_2
	49	43	52	54	53	60
Vocabulary Pretest	26.58	24.34	26.68	29.37	28.25	29.52
Map Pretest	17.92	15.60	18.65	20.67	25.54	21.17
Map Posttest	23.97	20.74	22.03	23.54	24.50	24.52
Graph Pretest	13.03	11.18	11.79	13.05	12.73	14.29
Graph Posttest	13.91	13.72	14.30	14.96	15.11	14.35
Criterion Posttest	25.78	25.09	28.47	29.47	27.63	28.71

Findings for Hypothesis 1

The first hypothesis stated in the null form was that if adjustment is made for initial differences in vocabulary, map reading, and graph reading skills, there will be no significant difference in scores on a researcher-constructed criterion posttest between treatment groups. Figure 11 summarizes the data related to this first hypothesis.

FIGURE 11

ANALYSIS OF VARIANCE FOR

MAIN EFFECTS, INTERACTION, AND COVARIATES

ON CRITERION POSTTEST

Source	Degrees of Freedom	Sum of Squares	Mean Square	F
Total Sum of Squares	310	35167.18		
Model Sum of Squares	8	22907.36	2863.42	70.54*
Error Sum of Squares	302	12259.83	40.60	
Grade	2	318.86	159.43	3.93*
Treatment	1	1.07	1.07	.03
Grade by Treatment	2	176.14	88.07	2.17
Vocabulary Pretest	1	2754.66	2754.66	67.86*
Map Pretest	1	1172.37	1172.37	28.88*
Graph Pretest	1	490.80	490.80	12.09*

*Indicates F ratios that are significant at the .05 level.

The F ratio associated with the treatment effect was .03, an extremely low value, so it was not large enough to reject the null hypothesis at the .05 level of significance.

The reason this extremely low F value was obtained is illustrated in Figure 12. This figure shows that when the raw score means of the T_1 and T_2 groups were adjusted for differences in the predictor variables, they were very nearly the same.

FIGURE 12

COMPARISON OF RAW SCORE AND ADJUSTED MEANS ON THE CRITERION POSTTEST FOR TREATMENT 1 AND TREATMENT 2

Treatment	Raw Score Mean	Adjusted Mean
Treatment 1	27.62	27.82
Treatment 2	28.00	27.94

The second main treatment effect related to the first hypothesis is the effect of grade. The F ratio associated with grade was 3.93, which was significant at the .05 level. An analysis of this effect using the Duncan Multiple Range Test indicated that all grades were not homogeneous with each other.

Figure 13 (p. 65) shows that the performance of grades 5 and 6 on the criterion posttest was homogeneous when the means were adjusted for the predictor variables.

FIGURE 13

SUMMARY OF RESULTS OF THE DUNCAN MULTIPLE RANGE TEST AT THE .05 LEVEL OF SIGNIFICANCE FOR GRADE LEVEL EFFECT ON THE CRITERION POSTTEST

Grade	Homogeneous With
6	5
5	6, 7
7	5

This figure also indicates that the performance of grades 5 and 7 were homogeneous. The significant difference that was indicated in the F ratio was between the adjusted means of grades 6 and 7. Figure 14 shows the adjusted mean for grade 6 to be 28.92 while the adjusted mean for grade 7 was 26.52.

FIGURE 14

RESULTS OF DUNCAN MULTIPLE RANGE TEST AT THE .05 LEVEL OF SIGNIFICANCE FOR MEAN SCORES ON THE CRITERION POSTTEST

Grade	Constant	Standard Error of the Constant	Means
5	.33	.55	28.82
6	1.04	.51	28.92
7	-1.36	.52	26.52

Figure 11 also indicated that the three covariate measures were highly correlated with criterion test performance so that they were appropriate for use as predictor variables.

Findings for Hypothesis 2

The second hypothesis stated in the null form was that if adjustment is made for initial differences in map reading skills, there will be no significant difference in scores on a standardized posttest of map reading skills between the treatment groups. Figure 15 summarizes the data related to the second hypothesis.

FIGURE 15

ANALYSIS OF VARIANCE FOR

MAIN EFFECTS, INTERACTION, AND COVARIATES

ON MAP SKILLS POSTTEST

Source	Degrees of Freedom	Sum of Squares	Mean Square	F
Total Sum of Squares	310	20873.96		
Model Sum of Squares	6	13191.15	2198.52	86.99*
Error Sum of Squares	304	7682.81	25.27	
Grade	2	48.81	24.40	.97
Treatment	1	.35	.35	.01
Grade by Treatment	2	41.73	20.87	.83
Map Pretest	1	12450.13	12450.13	492.64*

*Indicates that the F ratio is significant at the .05 level.

The F ratio associated with the treatment effect for this comparison was .01, an extremely low value, so it was not large enough to reject the null hypothesis at the .05 level of significance.

The Duncan Multiple Range Test indicated that Treatment 1 and Treatment 2 were homogeneous with each other and that the adjusted mean performance on the standardized map test was homogeneous for all grade levels.

Findings for Hypothesis 3

The third hypothesis stated in the null form was that if adjustment is made for initial differences in graph reading skills, there will be no significant difference of scores on a standardized posttest of graph reading skill between the treatment groups. Figure 16 (p. 68) summarizes the results of the analysis of the data related to the testing of the third hypothesis.

FIGURE 16

ANALYSIS OF VARIANCE FOR

MAIN EFFECTS, INTERACTION, AND COVARIATES

ON GRAPH SKILLS POSTTEST

Source	Degrees of Freedom	Sum of Squares	Mean Square	F
Total Sum of Squares	310	11104.98		
Model Sum of Squares	6	5333.26	888.88	46.82*
Error Sum of Squares	304	5771.72	18.99	
Grade	2	30.01	15.00	.79
Treatment	1	8.01	8.01	.42
Grade by Treatment	2	59.78	29.89	1.57
Graph Pretest	1	5234.93	5234.93	275.73*

*Indicates that the F ratio is significant at the .05 level.

The F ratio associated with the treatment was .42, which was not large enough to reject the null hypothesis at the .05 level of significance.

The Duncan Multiple Range Test compared the adjusted means for the Treatment 1 and Treatment 2 groups and found them homogeneous.

The F ratio associated with the second main effect, grade level, was .79, which was also not large enough to be significant at the .05 level. The Duncan Multiple Range

Test compared the adjusted means for all grade levels and showed them to be homogeneous.

Discussion of the Findings

The findings of this study were reported in relation to the treatment effect and grade effect. The data was analyzed using an univariate least-squares analysis of covariance and was reported in terms of the three original hypotheses stated in Chapter I.

The main treatment statistical hypothesis, that there was no difference between treatment groups using the materials organized according to the Forced Inferential Response Mode learning format and those using materials presented in the form of a written narrative, could not be rejected for any of the three hypotheses tested.

The grade level effect was not significant for the second and third hypotheses which compared performance on the post-administration of the Iowa Tests of Basic Skills, Form 5, Level 12, Test W1, Map Reading, and Test W2, Reading Graphs and Charts. Grade level performance was significantly different when comparing the adjusted means for the criterion posttest. This difference was illustrated in the results of the Duncan Multiple Range Test which indicated that while the performance of grades 5 and 6 and 5 and 7 were homogeneous, the performance of grades 6 and 7 were significantly different.

The results of these findings indicated that the differences in gains between treatment groups were not statistically significant. However, the students in both treatment groups significantly improved their skill in reading maps and graphs between the administration of the pre- and posttest.

Figures 17 and 18 present a comparison of the pre- and posttest raw mean scores on the map reading and graph reading tests.

FIGURE 17

MEAN DIFFERENCE BETWEEN PRETEST AND POSTTEST SCORES ON THE TEST OF MAP READING SKILLS

Treatment Groups	Test Means		Degrees of Freedom	t	Level at Which the t-Ratio is Significant
	Pretest	Posttest			
T_1	20.21	23.31	306	3.35	.01
T_2	19.85	23.08	312	3.55	.01

FIGURE 18

MEAN DIFFERENCE BETWEEN PRETEST AND POSTTEST SCORES ON THE TEST OF GRAPH READING SKILLS

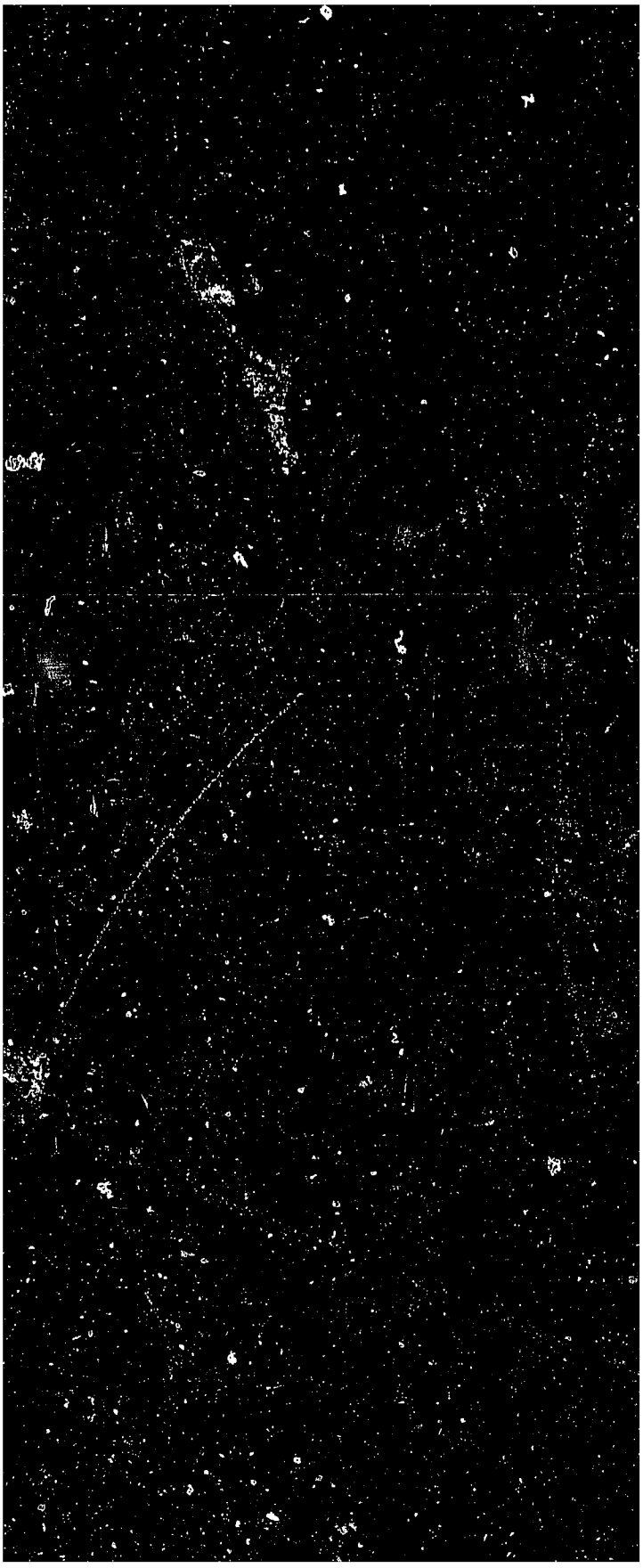
Treatment Groups	Test Means		Degrees of Freedom	t	Level at Which the t-Ratio is Significant
	Pretest	Posttest			
T_1	12.69	14.56	306	2.65	.01
T_2	12.96	14.34	312	2.03	.05

These scores indicated that significant learning gains occurred for both treatment groups on both tests. On the test of map reading skills, the T_1 and T_2 groups both achieved learning gains that were significant at the .01 level. Similarly, significant improvement was made by the T_1 group on the graph reading test, while the T_2 group had a t-ratio of 2.03 which was significant only at the .05 level.

Results from the criterion posttest showed no significant difference between the treatment groups. The unadjusted mean score for all students in the sample was 28.81. Since this score was far above a pure chance score on a 50-item, 4-option, multiple-choice test, it was interpreted as showing that students using the T_1 and T_2 materials significantly increased their knowledge of the demographic and geographic characteristics of the United States and Mexico.

Survey of Student and Teacher Reactions

Following the completion of the field testing phase by the seventh graders at Pattie Hilsman Junior High School, a survey was conducted to assess student reaction to the content and the treatments. The majority of students in both treatment groups reported that they had enjoyed working with the unit materials and that they thought the content area was interesting and important. The percentage of students who reported positive reaction to the materials was greater than 75% for both treatment groups, with slightly more



students in the T_1 than the T_2 group expressing postive reactions toward the unit.

One variable that may have contributed to the generally favorable attitude of students toward the unit was that the school in which the survey was conducted was involved in an environmental education campaign, and most students viewed population growth as a phenomenon closely related to the environmental controversy.

No formal survey of teacher reaction toward the unit was conducted, but the researcher had almost daily conversations with the participating teachers. These teachers seemed to feel that short, self-instructional units on important topics such as population growth were of great value to the students. There was also a general attitude among the teachers that the more structured format of the FIRM treatment was more suitable for their slower students, and that the FIRM treatment was of greater value in promoting skill development in all of their students.

Before basing firm conclusions on the data collected in this study, it is necessary to review these findings in light of the major limitations to internal validity of the study. The first stated limitation was the use of the Iowa Tests of Basic Skills as both a measure of the predictor variables of pre-treatment skill in vocabulary, map reading, and graph reading, and the use of the same instruments for measuring post-treatment gains in map and graph reading skills. This

not only led to the danger of students becoming test wise, but the standardized nature of the tests provided a more general measure of graphic skills and did not include specific types of graphics that were emphasized in the population content materials used in the study. Although an alternate form of these tests was available, their inclusion in booklet form in the total battery of Iowa Tests of Basic Skills for grades 3 through 8 made the purchase cost of the alternate form prohibitive.

The second limitation to internal validity stated in Chapter III was the inability of the researcher to control for the amount of time each student spent in learning. This factor may have substantially affected each treatment group's performance because the groups using the FIRM format required more time to study the graphics from which the differentiated responses were to be paired with the proper stimuli. The Treatment 2 group simply read the narrative and used the graphics to provide visualization and reinforcement for the concepts they had already encountered in their reading.

In conclusion, the data collected in this study does not support the hypothesis that the FIRM instructional alternative is superior to the written narrative format supplemented with graphics for the teaching of population geography concepts, or for the teaching of map reading and graph reading skills to middle grade students. Rather, it indicates that both treatments made significant contributions

to concept learning and skills development among the students tested.

CHAPTER VI

SUMMARY, CONCLUSIONS, AND IMPLICATIONS FOR FURTHER RESEARCH

Summary

This section presents a summary of the research undertaken by the investigator.

Purpose

This study was conducted under the sponsorship of the Geography Curriculum Project of the University of Georgia and attempted to answer questions that reflected the goals of the Project. The purpose of the research can be stated as an attempt to answer three questions:

1. Can a systematically structured and conceptually organized population geography unit be developed that will be appropriate for use with middle grade students?

2. Is the FIRM instructional format more effective for teaching a population education unit than the more traditional narrative mode supplemented with graphics?

3. Can the FIRM instructional format be considered an application of the S-R reinforcement model?

The third question asked in the study related to the Project's goal of presenting geography curriculum materials in accordance with some accepted learning theory. This was a theoretical question that can only be answered based on

the logic used by the researcher in applying learning theory to the developed curriculum material and cannot be empirically supported by the results of the study.

Procedures

The procedures followed in conducting this study involved first reviewing the literature on the past use of S-R learning theory to teach geography at the middle grade levels. From this review and the past research of the Project Director, Dr. Marion J. Rice, the FIRM instructional mode was conceived and operationally defined.

Since this alternate form of the S-R reinforcement model included a data base composed of conceptual clusters, and because of the geographic and demographic nature of the materials, it was decided to utilize a data base composed solely of graphics. This decision prompted a review of the literature which related to the form and effectiveness of graphical illustrations in social studies texts and also included studies that showed the appropriateness of such media for the middle grades. This survey was expanded to include studies that compared graphics used in different roles because the function that graphics served under the FIRM format differed from the function graphics served in the written narrative form of the unit, "Population Growth in the United States and Mexico."

Following the format of FIRM and the more traditional structure of a written narrative supplemented with graphic

illustrations, two treatment units were developed to present the unit, "Population Growth in the United States and Mexico."

These units were pilot tested at three schools in Clarke and Oconee Counties, Georgia. From these schools, one fifth, sixth, and seventh grade class participated in the experiment. The results from this pilot phase of the study indicated procedural changes were needed and also provided a means for evaluating and modifying the posttest instrument. After analyzing the results of each question of this test according to its difficulty and discrimination power, the test was shortened and modified.

The field testing phase of the experiment involved 311 students from fifth, sixth, and seventh grade classrooms from Clarke County, Georgia. These students were randomly assigned to treatment groups. All students in the sample were given three parts of the Iowa Tests of Basic Skills, Form 5, Level 12, as a pretest, and two parts of the same test as a part of the post-treatment evaluation. In addition to the standardized test, all students were given the revised form of the researcher-constructed criterion posttest. Results from all tests were analyzed by the MUGALS (Modified University of Georgia Analysis of Least-Squares) computer program.

Findings in Relation to the Stated Hypotheses

The hypotheses stated in Chapter I related directly to the question, "Is the FIRM format more effective for the teaching of population education concepts and map and graph skills than the written narrative format supplemented with graphics?" The data collected in this experiment was based on the performance of groups using the two alternate instructional formats.

The findings of the study supported the hypotheses that there was no significant difference in performance between the treatment groups on a researcher-constructed criterion posttest or in gains on standardized tests of skill in reading maps or graphs.

More specifically, the findings reported in terms of the main effects of treatment and grade are listed below:

1. There was no significant difference between the performance of T_1 and T_2 on the researcher-constructed criterion posttest when adjustments were made for pre-treatment differences in vocabulary, map reading, and graph reading skills.

2. There was a significant difference between grades 6 and 7 on the criterion posttest in favor of grade 6 when adjustements were made for pre-treatment differences in vocabulary, map reading, and graph reading skills.

3. There was no significant difference between the performance of T_1 and T_2 on a standardized posttest of map reading skills when adjustments were made for pre-treatment differences in map reading skills.

4. There was no significant difference among the performance of grades 5, 6, and 7 on a standardized posttest of map reading skills when adjustments were made for pre-treatment differences in map reading skills.

5. There was no significant difference between the performance of T_1 and T_2 on a standardized posttest of graph reading skills when adjustments were made for pre-treatment differences in graph reading skills.

6. There was no significant difference among the performance of grades 5, 6, and 7 on a standardized posttest of graph reading skills when adjustments were made for pre-treatment differences in graph reading skills.

7. There was a significant improvement in map and graph reading skill made by both treatment groups between the administration of the pre- and posttest.

Conclusions

The conclusions drawn from this study are based on information collected and analyzed in conjunction with the study. These conclusions relate largely to the question of the feasibility of developing a population education unit appropriate for use with middle grade students. The third question asked in this study was "Can the FIRM instructional format be considered an application of the S-R reinforcement model?" An analysis of the relationship of the components of S-R theory to FIRM was discussed at length in Chapter III. The relationship of applied program characteristics of FIRM to programmed instruction, which frequently explains learning in S-R terms, was described in Chapter II.

In the judgment of the researcher, FIRM embodies the specific characteristics of the S-R reinforcement model, as described by Silverman (1969), and the principles of S-R learning, as described by Hilgard (1960). The researcher therefore answers this theoretical question affirmatively, that FIRM may be considered an application of the S-R reinforcement model, within the limitation of the discussion in this chapter. Because of the inferential nature of FIRM, however, another researcher might find it more compatible to explain FIRM as some variation of inquiry learning. As the field of learning theory indicates, similar learning phenomena are frequently interpreted quite differently by learning theorists (Klaus, 1965).

The following conclusions have been drawn by the researcher:

1. Population education curriculum materials can be effectively used by middle grade students.

2. Population education curriculum materials can be structured so that they can be used on a self-instructional basis by middle grade students.

3. The FIRM instructional format can be effectively used to teach population education concepts to middle grade students.

4. The FIRM instructional format can be effectively used to teach map and graph interpretation skills.

5. The FIRM instructional format and the more traditional approach of using a written narrative supplemented with graphical illustrations are both effective strategies for presenting a self-instructional middle grade population unit.

6. The learning gains made by groups using the FIRM format and the written narrative approach are not significantly different.

7. The self-instructional conceptually organized unit, "Population Growth in the United States and Mexico," is every bit as appropriate for use with grades 5 and 6 as with grade 7 when adjustments are made for the predictor variables of pre-treatment differences in vocabulary, map reading, and graph reading skills.

8. Graphical illustrations used in their primary role as conveyors of content, and in their alternate role as reinforcers and visualizers both produce gains in student ability to read and interpret maps and graphs.

9. Student scores on the Iowa Tests of Basic Skills test of map and graph reading skills will not be significantly different between groups using graphic illustrations in their primary role (conveyor of knowledge) and alternate role (reinforcer and visualizer).

Implications for Further Research

The conclusions that have been drawn from the analysis of the data collected in this study are generalizable within the limits of the external validity of the study. Implications for further research can be found in the threats to external validity which were inherent in the procedures and design of the study.

Since the study used pre-treatment tests to evaluate skill levels in the areas of vocabulary, map reading, and graph reading, the danger of reaction between the pre-measures and the instructional treatment existed. This danger was assumed to be minimized by the skill nature of the pretest, but further research using the FIRM instructional

format might employ an experimental design that does not include pre-treatment measures.

The sample used in the experiment was drawn from the population of fifth, sixth, and seventh grade students in the schools of Clarke and Oconee Counties, Georgia. Thus, the findings of the study can only be generalized to similar populations that have similar characteristics. This limitation implies the need for further research using the FIRM alternative at different grade levels and with populations that are socially and economically different from those used in this study.

The interaction of the FIRM instructional mode with materials that employ a data base composed solely of graphics suggests the need for further research in which some other form of conceptual cluster might be used to present the responses in place of the graphics.

Since this study made a comparison of graphical illustrations used in the role of content conveyors and content reinforcers, future research may evaluate the effectiveness of graphics used in other ways. An extension of this idea may be to compare graphical illustrations in their varying roles with materials presented in a purely narrative fashion. Past studies conducted by Vernon, Davis, and Burdick have made similar comparisons but their results have been inconsistent and contradictory.

Because the testing phase of the experiment involved the use of standardized tests of vocabulary, map reading,

and graph reading skills and a researcher-constructed criterion posttest, future application of the FIRM format might develop alternate testing programs to evaluate the effectiveness of FIRM.

The unit, "Population Growth of the United States and Mexico," was developed using the structure of population geography, a field which is characterized by the extensive use of statistical information to convey its message. As a result, there was a danger of interaction between the special characteristics of this field and FIRM learning strategy. A second feature of this unit that may have also interracted with the FIRM strategy was the purely cognitive nature of the materials presented. Future applications of FIRM should be made with units that utilize different content fields and with materials that have objectives that are affective in nature. These types of studies will help to define the limits within which this learning strategy can be effectively employed.

Since the generalizability of the findings of this study are limited to comparisons made between FIRM and the written narrative supplemented with graphics for presenting similar contextual material, future research might make comparisons between FIRM and other instructional strategies.

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